VOLUME 36 NUMBER 8 AUGUST, 1953

AMERICAN JOURNAL
OF
OPHTHALMOLOGY

THIRD SERIES FOUNDED BY EDWARD JACKSON

CONTENTS

DEPARTMENTS

For complete table of contents see advertising page xv

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intra ocular foreign body locators

TYPE 1—For determining location of foreign body in the lateral plane with X-Ray.

Made of Clear Plastic with Four Lead Dots centrally grouped around the insertion handle.

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Back to misery and a lowly C
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What glasses are best for you.
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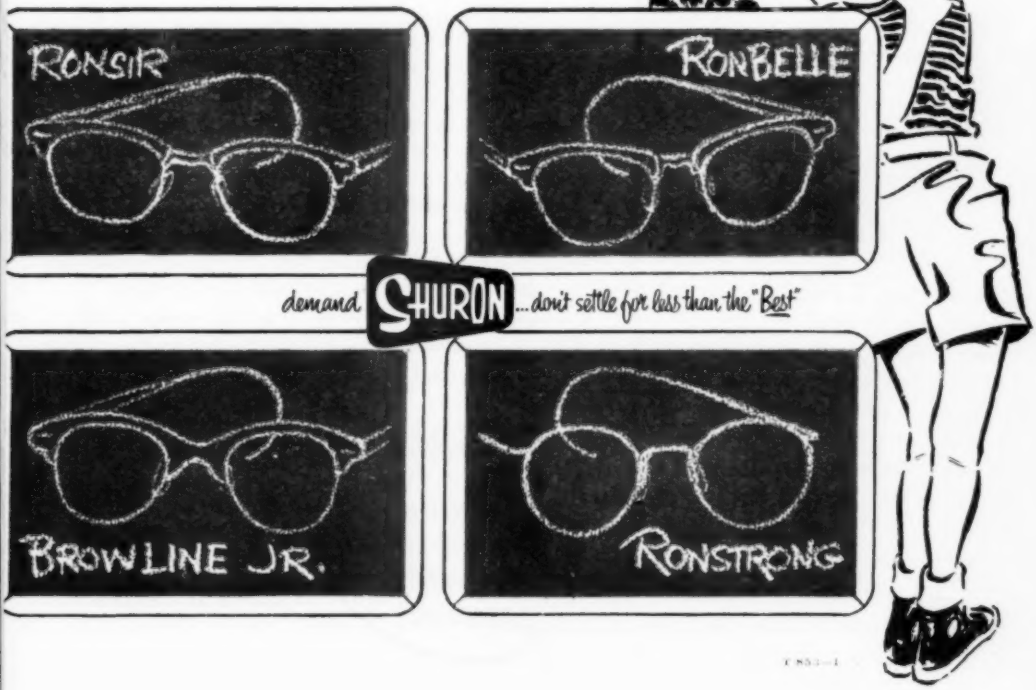
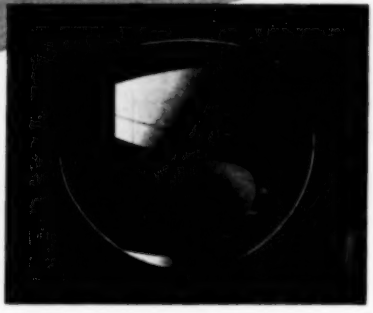
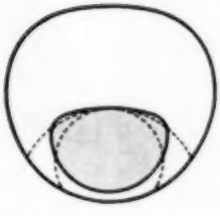


REQUIREMENT:

✓ Large reading field
✓ Adequate temporal and nasal distance view

℞ Large seg
Orthogon Panoptik





Panoptik Large Seg has segment 24mm wide x 16mm high. As compared with other segments, it provides widest reading field at accustomed reading level, and yet provides an extra area of distance correction on the sides.

Widest reading field—at normal level of reading habit—is provided by the Panoptik Large Seg bifocal. Yet, because of Panoptik scientific reading segment design—"flat" top with rounded corners—this reading field is achieved with minimum encroachment on distance portion. Admirably suited to decentration of segment to obtain nominal amounts of prism base-in or -out. In any prescription it affords your patients the required wide comfortable reading field, but makes possible the safety of "all-around" distance correction.
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1853 / 1953
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Ophthalmic Ointment of CORTONE Acetate with BACITRACIN controls both the symptoms and the cause of many ocular diseases. In certain inflammatory conditions of the anterior segment of the eye, this ointment serves to

- **promptly subdue tissue inflammation**
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- **reduce the possibility of secondary infection**
- **shorten morbidity**

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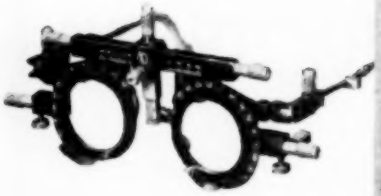
Most Popular TRIAL FRAME



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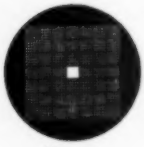

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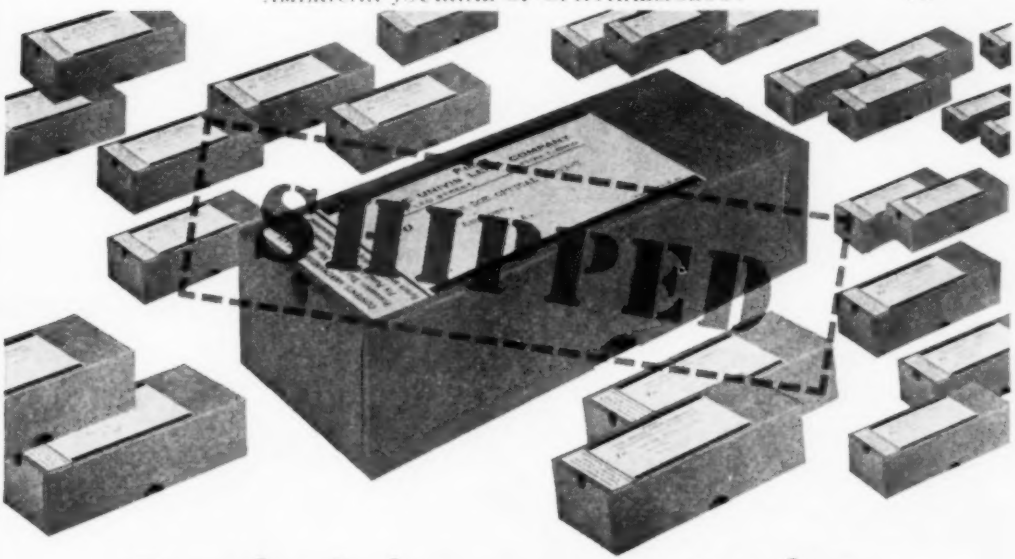
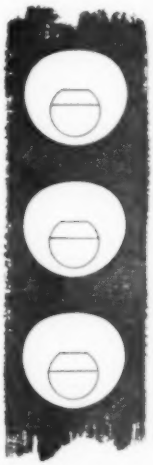


Everybody has a guarantee, but nobody tells you what happens!



This ad is about two significant optical "firsts."

1. Univis guarantees the *principle* behind Continuous Vision Lenses—not just the product itself—and has done so since January, 1951.

(As you undoubtedly know, Univis will replace any unsatisfactory CVs with Univis D bifocals, ground to Rx, free—whatever the cause of the dissatisfaction.)

2. Univis now gives you the *results* of this unprecedented guarantee.

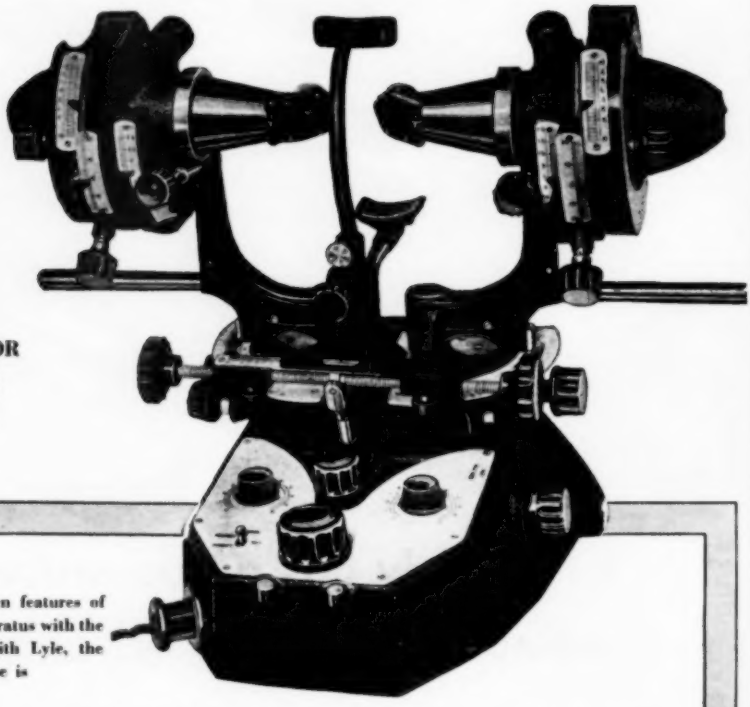
Since January, 1951, while CV use more than doubled, only 1.9% of the CVs shipped from our factory were returned for replacement under the unqualified guarantee.

98.1% satisfaction—what stronger evidence is there that the CV principle is sound?

THE UNIVIS LENS COMPANY • Dayton 1, Ohio

Write for your copy of the presbyopic prescription handbook.

univis



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(Standard Model)

Incorporating the proven features of previous Synotype apparatus with the suggestions of Mr. Keith Lyle, the Lyle Major Amblyoscope is

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Specially manufactured to meet the demands of present day technique, the Lyle Major Amblyoscope, Standard Model, incorporates the following improved features :

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SOLE AGENTS IN U.S.A. CURRY & PAXTON INC. C 101 PARK AVENUE, NEW YORK 17. TEL: LEXINGTON 2-7842

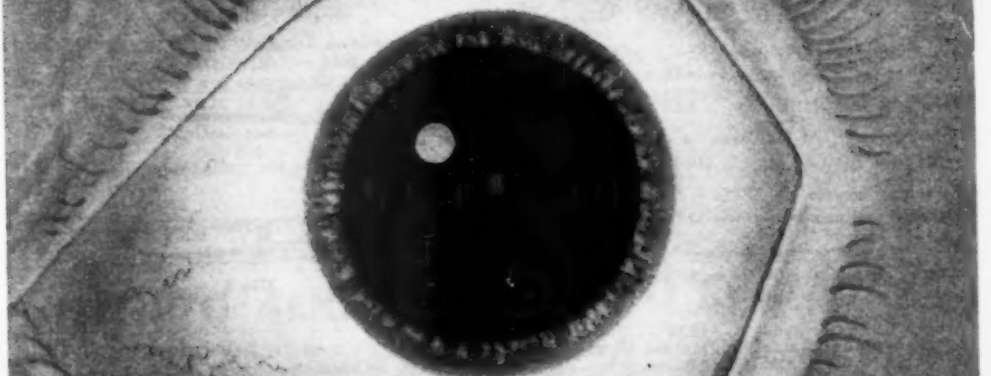
New Product...

for CYCLOPLEGIA and MYDRIASIS

CYCLOGYL

HYDROCHLORIDE

Brand of Cyclopentolate hydrochloride



Clinical investigation of CYCLOGYL has shown these properties

1. Rapid effect. Maximal cycloplegia in 30-60 minutes.
2. Satisfactory duration of action.
3. Rapid recovery. Complete within 24 hours without miotic . . . reduced to 48 hours *with* miotic.
4. Remarkably free from undesirable side reactions.
5. Little if any increase in intra-ocular tension due to Cyclogyl.
6. Effective in all age groups.
7. Effective in highly pigmented eyes normally refractory to cycloplegics and mydriatics.

Dosage and Administration for Cycloplegia —

Adults: Two drops 0.5% CYCLOGYL in each eye. In highly pigmented eyes, two drops 1.0% CYCLOGYL in each eye.

Children: One or two drops of either 0.5% or 1.0% CYCLOGYL, followed ten minutes later by second instillation; pretreatment the evening before refraction is not normally necessary with CYCLOGYL.

Supplied: 0.5% Sterile Ophthalmic Solution — 15cc Dropper Bottles
1.0% Sterile Ophthalmic Solution — 15cc Dropper Bottles

1. Gasteiger, E. C., and Longwell, L. H.: Arch. of Ophth. 49:91 (Jan.) 1953
2. Scobee, J. H.: Am. J. Ophth. (Jan.) 1953
3. Priestley, E. S., and Medow, M. S.: Am. J. Ophth. 34:572 (April) 1951

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266b* Forceps, Iris, CHANDLER **9.50**

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327a* Forceps, Suturing, CASTROVIEJO: teeth 0.9mm **10.50**

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389* Forceps, Muscle, GUNDERSON **14.50**

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* Stainless Steel

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266b

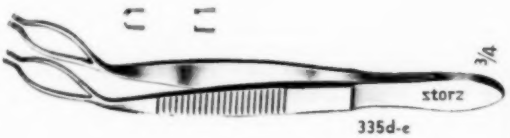
273b

247c

249½

300

327a-b



335d-e

389b

390b

405

326b

Storz Instrument Company

4570 Audubon Ave. **St. Louis 10, Missouri**

ZINCFRIN

DESCRIPTION: A non-stinging, non-irritating ophthalmic solution containing .25% Zinc Sulphate, Benzalkonium Chloride 1:5000 and .12% Phenylephrine Hydrochloride U.S.P. Tonicity and pH values adjusted to closely approximate those of tear secretions.

INDICATIONS: Infectious, allergic, catarrhal or inflammatory conjunctivitis in which the astringency of Zinc Sulphate combined with vaso constrictor properties of Phenylephrine HCI. USP may be desirable.

SUGGESTED DOSAGE: Adult and Child—Two or three drops in affected eye every three hours or as directed by physician.

AVAILABILITY: Zincfrin—Available in prescription pharmacies in 15cc blue dropper bottles. Literature and samples on request.

Manufactured by

ALCON LABORATORIES, INC., FORT WORTH, TEXAS

OP-THAL-ZIN

DESCRIPTION:
A non-stinging, non-irritating ophthalmic solution of Zinc Sulfate ¼% with pH and tonicity values closely approximating those of tear secretions with Benzalkonium Chloride 1:5000 as a "wetting agent" and preservative.

INDICATIONS:
Conjunctival infections in which the astringency of Zinc Sulfate is desirable. Morax-Axenfeld Bacillus, etc.

SUGGESTED DOSAGE:
Adult and Child—Two or three drops in affected eye every three hours, or as directed by Physician.

SUPPLIED: Op-thal-zin 15cc Blue Dropper Bottles.

AVAILABILITY: Available in prescription pharmacies in 15cc blue dropper bottles. Literature and samples on request.

Manufactured by

ALCON LABORATORIES, INC., FORT WORTH, TEXAS

ISOPTO ALKALINE

OPHTHALMIC VEHICLE:
Containing 1% Methyl Cellulose Ophthalmic in aqueous saline solution with Benzalkonium Chloride 1:50,000 as a preservative and "wetting agent."

INDICATIONS:
1. Ophthalmic emollient and lubricating agent in retarded lacrimation states, and as protective lubricant for pathologic conditions.
2. Vehicle for various soluble Ophthalmic Drugs: Antiseptics, Antibiotics, Sulfonamides and various alkaloidal salts.
3. As a physiologic non-greasy suspending agent for insoluble Ophthalmic medications: Cortisone, insoluble Sulfonamides, etc.

ADVANTAGES: Viscosity—plus soothing-lubricating effect—provides better and more prolonged contact of medication with affected area.

AVAILABLE: Isopto Alkaline available in prescription pharmacies in 15cc blue dropper bottles. Samples, literature and suggested prescription formulas available on request.

Manufactured by
ALCON LABORATORIES, INC., FORT WORTH, TEXAS

ISOPTO CETAMIDE

NEW PRODUCT
For increased efficacy of Ocular Sulfonamide therapy—with comfort.
Isopto Cetamide—contains Sodium Sulfacetamide, 15% w/v in soothing .5% Methyl Cellulose Ophthalmic Solution.

INDICATIONS:
Acute chronic conjunctivitis, acute traumatic corneal ulcer, blepharitis and other external eye infections caused by microorganisms susceptible to sulfonamide therapy.

- Comfortable to the eye.
- More intimate and prolonged eye surface contact.
- Better patient cooperation.
- Stable.

CAUTION:
This preparation should be used with care in the treatment of patients who have previously exhibited sensitivity to sulfonamides. Should undesirable reactions occur, discontinue use immediately.
Federal Law prohibits dispensing without a prescription.
Isopto Cetamide is available in 15cc blue dropper bottles in prescription pharmacies. Literature and samples available on request.

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Eases Ocular Irritation In Hay Fever...

STIVIN is a soothing eye drop which promptly nd effectively relieves ocular and nasal iscomfort due to

ay fever

llergic conjunctivitis

onjunctivitis due to
smoky, dusty, irritating air
presence of foreign bodies
the common cold

STIVIN is an aqueous infusion of "rosa gallica L."
It is decongestive and soothing to
inflamed ocular and nasal membranes.

STIVIN is non-toxic — safe.

osage: One drop of *Estivin* in each eye two (2) or three (3) times daily will alleviate discomfort, and relieve severe itching of the ocular and nasal membranes.

upplied: 0.25 fl. oz. DROPAK*
The DROPAK is a new disposable plastic container which delivers single accurately measured drops of *Estivin*.
Also supplied: 0.25 fl. oz. bottle complete with eye dropper

NEW
PORTABLE
ONE-DROP
"DROPAK"

END FOR OFFICE SUPPLY OF *ESTIVIN* IN NEW "DROPAK"

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Quality Integrity Service

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A SCIENTIFIC CORNER

WHERE OPTICAL PROBLEMS ARE DISCUSSED AND
THE SOLUTIONS, AS SOLVED BY EXPERIENCE, INDICATED!

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THE HOUSE OF VISION, INC.

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MUSKEGON
OAK PARK
MILWAUKEE
SIOUX CITY
AURORA
MINNEAPOLIS

CATARACT CENTERING

In a strong correction, chromatic aberration can occur in the distance portion of a bifocal as well as in the segment.

We have the history of Mrs. S. who is a monocular cataract case. She has very good vision in the operated eye and little or no vision in the other eye. The aphakic eye requires + 11.50 on + 3.00 axis 175 with + 3.00 add for reading.

This correction gave excellent near and distance vision but, with the bifocal lens, the patient complained at once that everything she looked at was tinged with blue. Surprisingly, objects viewed through the distance lens were just as blue as those seen through the bifocal segment.

An examination of the lens revealed no grinding defects. The surfaces were well polished and the correction and axis were perfect. However, a check of the centering revealed that when the patient looked straight ahead the optical center of the lens was 3 millimeters off the visual axis. This poor centering resulted in 6 prism diopters of error.

Before making a new lens for Mrs. S. this prism was neutralized by placing a 6 degree prism base in over the lens to offset the 6 degree error which was base out. The patient reported immediately that the blue cast was gone.

A new lens, perfectly centered, was made and the patient reports no chromatic aberration whatsoever.

Cases like this point up the fact that proper centering is just as important in monocular fitting as in binocular fitting. Too often, badly centered lenses are passed on to the patient with the false justification that since only one eye was being used the centering was of no importance.

"IF IT'S A LENS PROBLEM, LET'S LOOK AT IT TOGETHER"

AMERICAN JOURNAL OF OPHTHALMOLOGY

SERIES 3 · VOLUME 36 · NUMBER 8 · AUGUST, 1953

CONTENTS

Original Articles

Notes, Cases, Instruments

Society Proceedings

Editorials

Book Reviews

Abstracts

NEW

OpH TRADEMARK Eye Drops

STERILE BUFFERED SOLUTION

DECONGESTANT · ASTRINGENT ANTISEPTIC

CONTAINS Neo-Synephrine® hydrochloride.....0.08 (1/12)%
For Prompt and Prolonged Decongestant Action
Zinc Sulfate.....0.06%
Astringent and Antiseptic
Boric Acid.....2.2%
For Nonirritating Antisepsis
Chlorobutanol.....1 grain per fl. oz.
For bacteriostasis

WINTHROP

℞ **OpH** a dependable, soothing eye lotion for temporary relief of the congestion and discomfort due to minor ocular irritations.

SUPPLIED in unique sealed dropper-vial of 10 cc. protecting sterility

Winthrop-Stearns INC. NEW YORK 18, N. Y. WINDSOR, ONT.

Neo-Synephrine, trademark reg. U. S. & Canada, brand of phenylephrine. OpH trademark

AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 36 AUGUST, 1953 NUMBER 8

THE EFFECT OF ADRENAL CORTEX HORMONAL THERAPY ON EXPERIMENTAL BRUCELLA UVEITIS*

RONALD M. WOOD, PH.D., BERNARD BECKER, M.D., AND ALAN C. WOODS, M.D.
Baltimore, Maryland

The object of this experiment was to determine if the adrenal cortex hormones exerted a favorable or unfavorable effect on an experimental nontuberculous granulomatous uveitis.

It has previously been shown[1] that when immune-allergic tuberculous rabbits were treated with these hormones, treatment beginning at the time of the inoculation of the eyes, the entire character of the ensuing ocular tuberculosis was altered. It was changed from a restrained tuberculosis, which burned out in two to four months with moderate residual damage, to the fulminating destructive type of disease usually leading to rupture of the eyes and ordinarily seen only in normal, nonimmune animals.

It has also been observed[2] that many patients with granulomatous uveitis pursued an unfavorable course after intensive hormonal therapy. Some of these unfavorable cases were probably tuberculous, but in others the etiology of the uveitis was obscure. It was therefore important to explore experimentally the effect of this hormonal therapy in nontuberculous granulomatous uveitis.

Brucella organisms were selected as the agents to produce such a granulomatous uveitis for the reasons that in immune animals they frequently produce granulomatous lesions of the tuberculoid type,[3] that there is considerable reason to believe chronic brucellosis may be the etiologic factor in a fair percentage of endogenous ocular disease,[4-9] and that the organisms lack the protective waxy capsule of the *Mycobacterium tuberculosis*, and thus may afford a fairer test for the efficacy of a therapeutic agent.

Since the use of immune-allergic rabbits, in an already lengthy experiment, makes it necessary to keep the infected rabbits over a protracted period of time, and since the incidence of laboratory infections with the Brucella organism is extremely high, the animals used in this experiment were housed in the special Brucella laboratory of the National Institutes of Health at Bethesda, Maryland, where unusual facilities for the prevention of infection are available. The inoculations, clinical observations, and autopsies were performed at Bethesda. All other laboratory procedures were done in the Wilmer Institute laboratories. We take this opportunity to express to Dr. Norman McCullough, the director of the Brucella laboratory at Bethesda, our thanks and appreciation for the splendid coöperation afforded us and his helpful advice during the course of the experiment.

OUTLINE OF EXPERIMENT

On December 7, 1951, 75 normal rabbits were inoculated intravenously with virulent Brucella abortus organisms. Thereafter, at varying intervals, the agglutination titers of their sera were determined, and the development of hypersensitivity ascertained by intracutaneous tests with brucellergen. While these rabbits gradually became immune, vari-

* From the Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital.

ous pilot experiments to determine the proper dose for ocular inoculation were performed on a series of already immune rabbits given us by Dr. McCullough.

By February 20, 1952, the rabbits used in this experiment had developed what appeared to be a satisfactory immune-allergic status, the agglutination titers varying usually from 1:80 to 1:1,240, and the majority showing definite cutaneous reactions to Brucellergen. A very few rabbits were nonreactive, giving titers of less than 1:80 or insignificant skin reactions.

At this time there were 68 survivors. All rabbits were inoculated February 20, 1952, in the right eyes with the dose of organisms which had produced satisfactory lesions in the previously tested immune-allergic rabbits. These rabbits were then divided into five groups, care being taken to have rabbits of equal agglutination titers and cutaneous reactivity in each group.

Group I, containing 15 rabbits, was left untreated as controls.

Group II (15 rabbits) was treated with cortisone by parenteral injection—10 mg. per diem.

Group III (15 rabbits) was similarly treated with hydrocortisone.

Group IV (15 rabbits) was treated with corticotropin, 10 mg. once daily in long-acting ACTHAR vehicle.

Group V (8 rabbits) was treated with cortisone ointment, 25 mg./gm., in the conjunctival sac twice daily.

There was a heavy mortality in the cortisone- and hydrocortisone-treated rabbits and on March 7, 1952, the dose of both cortisone and hydrocortisone was reduced to 5.0 mg. per diem.

The injected right eyes of the untreated controls developed an allergic reaction to the inoculum (see below) which subsided within one week. To test further the ocular hypersensitive status, on February 26th the left eyes of all animals, both control and treated, were injected with 0.05 cc. of a sterile, standard Brucellergen antigen.

The right eyes injected with the Brucella inoculum of bacilli did not uniformly develop the lesions shown by the rabbits in the pilot experiment. At this time it was not clear whether this failure to develop uniform lesions was due to a defect in the inoculum or to a high acquired immunity which might be possessed by these rabbits. Therefore, to salvage the experiment and to provide a greater number of eyes for observation, on March 11th, the left eyes of all animals were injected in the anterior chambers with a freshly prepared inoculum.

The eyes were examined clinically at the end of 24 hours, 72 hours, and one week after the ocular inoculations and thereafter, during the course of the experiment, up to the time treatment was stopped on April 18th, at weekly intervals. All the readings were recorded on a 0 to 4 numerical scale, as in the former experiments on ocular tuberculosis.

After cessation of treatment on April 18, 1952, all animals were left untreated for 52 days, to give a posttreatment period for observation of any recurrences.

From June 5th to 9th, final agglutination titers and cutaneous sensitivity tests were done. The surviving animals were then killed, autopsied, the eyes removed for section, and specimens of the lungs, kidney, spleen, and adrenals taken for histologic examination.

Cultures were made from the various viscera, and the uveal tracts of all rabbits whose eyes showed activity at the time of death. The blood, liver tissue, bile, and spleen were cultured on all rabbits, regardless of any ocular activity. Any enlarged lymph nodes were also cultured.

Bacteriologic technique

A smooth virulent culture of Brucella abortus strain No. 2308 was used throughout this experiment.

The organisms were grown for 48 hours on tryptase-soy agar plates, washed off with sterile 0.85-percent sodium-chloride solution, and the number standardized on a previously

calibrated spectrophotometer.

The initial injection given all animals consisted of 1,000 organisms suspended in 1.0 ml. of physiologic saline. The injections were given intravenously into the marginal ear vein.

The right eyes were inoculated by withdrawing 0.2 ml. of aqueous and then injecting 0.2 ml. of a suspension of Brucella abortus standardized to contain 100,000 organisms per 0.2 ml.

The left eyes were injected with 100,000 organisms contained in a volume of 0.05 ml. In this case aqueous was not removed previous to the injections, because the volume injected was relatively small.

The agglutination tests were done by the tube dilution technique using standardized Brucella antigen prepared by the U. S. Department of Agriculture, Bureau of Animal Industry. The tests were incubated for 48 hours at 37°C.

The cutaneous sensitivity tests were performed with standardized commercial Brucellergen as the test antigen. One-tenth ml. was injected intracutaneously and the reactions were read at 24 and 48 hours following the injection.

Culture technique

The cut surfaces of the liver, spleen, and lymph nodes were macerated by repeated clipping with sterile scissors and then rubbed on the surface of tryptase-soy agar plates.

Blood cultures

Ten ml. of blood were obtained by cardiac puncture. Five ml. were inoculated into each of two flasks, one containing trypticase-soy broth with one-percent sodium citrate and the other containing McCullough's synthetic medium. These flasks were subcultured onto trypticase-soy agar plates at intervals of 4, 7, 14, and 21 days.

Bile

0.5 to 1.0 ml. was aspirated from the gallbladder and inoculated into trypticase-soy broth containing one-percent sodium citrate. Subcultures were made to trypticase-soy plates at intervals of 4, 7, 14, and 21 days.

Eye

The uveal tract was dissected out, macerated with sterile scissors, and rubbed directly on the surface of trypticase agar plates. The tissue was then ground into a sterile mortar with sand and 1.0 ml. saline. This material was then surface inoculated on trypticase-soy agar plates in 0.2 ml. quantities per plate.

Results

I. Clinical

When rabbits are systemically infected with living Brucella organisms, they not only acquire some resistance to later reinfection, but they also become hypersensitive to the Brucella organisms. When eyes of these animals are later injected with the Brucella inoculum, they develop, within 24 to 48 hours, an allergic, nongranulomatous inflammatory reaction. This is a well-recognized example of bacterial allergy, and is known as the "ophthalmic reaction." It usually lasts for three to seven days, after which the eyes may recover and remain free of inflammation or may develop a reaction of actual infection. This ophthalmic allergic reaction may merge into the reaction of bacterial infection.

In this experiment, in some eyes the allergic reaction subsided and the eyes remained permanently free of inflammation, in others there was a short period before the delayed reaction of actual bacterial infection developed and, in still others the allergic reaction merged into the reaction of infection. In general the incubation period from inoculation to the development of actual lesions was a minimum of one week.

The delayed reaction of infection varied considerably in intensity. In general two types of reaction were observed, which may be termed "minor" and "major" reactions.

The minor reactions were characterized by pericorneal infection, the occurrence of

one or more nummular infiltrates in the corneas followed by slight corneal vascularization. The iris became thickened, but there were no visible nodules. A few posterior synechias formed. There were no keratic deposits.

Such a kerato-uveitis persisted for a period of three to six weeks and then subsided, the eyes thereafter showing few, and sometimes no, residua.

The major attacks were more severe. The symptoms of anterior ocular inflammation were more intense and there were sometimes exudates in the anterior chambers. A few rabbits showed ophthalmoscopic evidence of an exudative chorioretinitis and occasionally of an endophthalmitis. The duration of the attack was much longer, from nine to 10 weeks in most instances, or persisting up to the natural death or the killing of the animals.

For statistical study in this paper reactions of less than a maximum of "2" were regarded as minor reactions, and reactions of "2" or more were regarded as major reactions.

The clinical symptomatology, character, and course of the major and the minor reactions were essentially the same in both the control and treated rabbits with three notable exceptions. These exceptions were:

1. The complete or almost complete suppression of the allergic ophthalmic reaction in the treated rabbits.

2. An increased incidence of major and minor reactions in the left eyes (chiefly in the controls).

3. An increased severity of the major infectious reactions in the reacting treated animals, as compared to similar reactions in the reacting controls.

A. *Suppression of the allergic ophthalmic reaction*

The incidence of the positive and negative allergic ophthalmic reactions, together with the intensity of the positive reactions, are shown in Table 1. It is immediately apparent that in the untreated controls (Group I) the anterior-chamber injection of the inoculum in both eyes and of Brucellergen in the left eye, produced strong allergic reactions in all rabbits.

The situation in the eyes of the rabbits of the various groups (II, III, IV) receiving parenteral hormonal therapy may be summarized as follows:

Forty-five right eyes received the Brucella

TABLE 1

INCIDENCE AND INTENSITY OF POSITIVE ALLERGIC OPHTHALMIC REACTIONS IN TREATED AND UNTREATED RABBITS

	Right Eye Reaction to Inoculum (Feb. 20)		Left Eye Reaction to Brucellergen (Feb. 26)		Left Eye Reaction to Inoculum (Mar. 11)	
	Positive	Negative	Positive	Negative	Positive	Negative
Untreated controls (Group I)	15 (0.9)	0	15 (1.0)	0	15 (1.4)	0
Parenteral cortisone treated (Group II)	2 trace	13	1 trace	13*	9† (0.6)	4
Parenteral hydrocortisone treated (Group III)	6 trace	9	2 (0.3)	13	4 (0.3)	9†
Parenteral corticotropin (Group IV)	3 trace	12	6 (0.3)	9	3 (0.5)	12
Topical cortisone	3 trace	5	4 trace	4	3* (0.3)	4

* One rabbit dead.
† Two rabbits dead.

TABLE 2

INCIDENCE OF MINOR INFECTIOUS REACTIONS

Group	No. of Reacting Rabbits		Average Incubation Period	
	Right Eye	Left Eye	Right Eye (weeks)	Left Eye (weeks)
I	2	9	1	1
II	1	2	2	1
III	1	2	1	1.5
IV	0	2	—	1
V	1	0	5	—

inoculum, and, in 34 of these, the reaction was completely suppressed; in the 11 reacting eyes there was only a trace of inflammation.

Forty-four left eyes received the Brucellergen one week later and, in 35 of these, there was complete suppression of the allergic reaction, while the reacting eyes showed either a bare trace of inflammation or a maximum 0.5 reaction. However, when these same left eyes received the Brucella inoculum two weeks later, of the 41 survivors, there was suppression of the allergic reaction in only 25 eyes, 16 eyes showing quite fair reactions. This increased susceptibility of the left eye to a second injection of antigen is commented upon in the next section.

In the eyes receiving topical cortisone, the reaction to the Brucella inoculum and Brucellergen was suppressed in approximately 50 percent of the injected eyes, and was of low intensity in the reacting eyes.

This complete or partial suppression of the ophthalmic allergic reaction to the Brucella antigens by adrenal cortex hormone therapy resembles exactly a similar suppression of the ophthalmic reaction in the tuberculous eyes of animals injected systemically with tuberculin, and to the suppression of the bacterial ophthalmic allergic reaction to streptococci by the same hormonal treatment. These results have already been reported and commented upon in previous communications.

B. *Increased incidence of infectious reactions in left eye*

Tables 2 and 3 show respectively the incidence of minor and major reactions in the right and left eyes of the untreated controls and of the treated rabbits of the various groups.

From Table 2 it is obvious that there was no difference in the incidence of minor reactions in the right eyes of the untreated controls (group I) and the treated groups (groups II, III, IV, and V). In the left eyes of the untreated controls there was a significantly higher incidence of minor reactions—nine out of 15 eyes, or 60 percent, showing the minor reactions of infection; while in the treated groups the incidence of minor reactions in the left eyes was slightly greater than in right eyes (six in the left eye, three in the right eye).

The same phenomenon is seen in the incidence of major reactions (table 3). In the right eyes of the untreated controls there

TABLE 3

INCIDENCE, DISTRIBUTION, INTENSITY, AND DURATION OF SEVERE REACTIONS

Group	No. of Reacting Rabbits			Average Incubation Period (weeks)	Average Severity	Average Duration Recovered Rabbits* (weeks)
	Total	R.E.	L.E.			
I. Controls	6	2	4	1.3	2.3	6
II. Cortisone	5	2	3	1.6	3.0	10
III. Hydrocortisone	3	2	1	3.3	2.8	7.5
IV. Corticotropin	2	1	1	2.5	3.0	9
V. Topical Cortisone (8 rabbits only)	2	1	1	5	3.0	all active at death

* Eight rabbits with actively inflamed eyes died or were killed. Duration of reactions at time of death or killing; 3–9 weeks.

were two major reactions and these were of low intensity and short duration. In the right eyes of the treated rabbits, there was a statistically similar incidence of major reactions. In the left eyes, however, there were four major reactions in the untreated controls, while in the treated rabbits there was a lower incidence of such reactions but statistically the same as that of the right eyes.

What are the possible explanations for this increased incidence of reactions in the left eyes of the controls?

It cannot be attributed to any defect in the inoculum used in the right eyes, for the incidence of minor and major reactions was the same in the right eyes of all five groups, and the major reactions were the same in the left eyes of the four treated groups.

If the left eyes only were considered, the decreased incidence of reaction in the treated group as compared to the controls might well be considered the result of the hormonal therapy and indicate some control of granulomatous inflammation by the adrenal cortex hormones. In this respect it should be noted that, whereas the hormonal treatment was begun at the time the right eyes were inoculated, the animals had all received 19 days of hormonal therapy prior to the inoculation of the left eyes.

It is therefore possible that this preceding treatment in Groups II, III, IV, and V may have had some inhibitory effect on the outbreak of the minor infectious reactions in the left eyes of the treated groups. There is, however, another important point that must be considered.

In the preceding section (A), it was pointed out that the right eyes reacted to the Brucella inoculum and the left eyes to Brucellergen in a similar manner. However, when the left eyes were later injected with the Brucella inoculum there was a decided increase in the incidence and severity of the positive allergic reactions. In other words, these eyes had become more susceptible to the antigen.

It has long been known that traumatized tissue is a favorite place for the development of inflammatory reactions from various insults. A classical example of this is the proved predilection of the Treponema pallidum for traumatized tissue and the tendency for syphilitic lesions to develop in such tissue. Thus it appears probable that the increased incidence and severity of the second allergic reaction in the left eyes may be related to the previous allergic trauma produced by the Brucellergen injection.

The increased incidence of minor and major infectious reactions in the left eye was chiefly in the untreated controls. It should be noted that prior to the development of these infectious reactions these left eyes had been subjected to two severe traumatic allergic insults (to the Brucella inoculum and to Brucellergen). In contrast, the right eyes had undergone only one such insult (to the Brucella inoculum.) The two possible explanations for the increased incidence of both major and minor reactions in the left eyes of the controls as compared to the treated rabbits are: (1) An inhibitory effect exerted by the preceding 19 days' hormonal therapy on the treated groups, and (2) the predisposition to inflammation resulting from the trauma of the double allergic insult in the left eye of the controls.

C. *Increased severity of major infectious reactions in the treated rabbits*

Six untreated controls (group I) and 12 treated rabbits (groups II, III, IV, and V) showed major reactions in either the right or left eyes. In the various individual groups there was no essential difference between the reactions of the right and the left eyes.

In the untreated controls, however, the reactions were less severe than in the treated rabbits—the incubation period was shorter, the severity of the lesions less intense, and the duration of the disease shorter. These figures are shown in Table 3.

In the controls the incubation period was from one to two weeks with an average of 1.3 weeks, the average severity of the lesions

2.3, and the duration of the inflammation in the spontaneously recovered rabbits was six weeks. In the treated animals, the incubation period varied from one to seven weeks with an average of 2.7 weeks, the average severity of the disease was 2.9, and the duration in the recovered rabbits 9.5 weeks.

The only differences between the control and the treated rabbits were (a) that the control eyes had undergone a preceding allergic reaction which had been completely or partially suppressed in the treated animals, and (b) the treated rabbits had received hormonal therapy. It appears impossible to attribute the decreased severity in the control rabbits to the preceding allergic trauma, which would have predisposed, rather than inhibited, a subsequent infectious reaction. The conclusion appears inescapable that the increased severity and longer duration of the reaction in the treated rabbits is related to the hormonal therapy.

These findings would indicate that any action hormonal therapy may have on the ocular inflammation produced by the inoculation of Brucella is an unfavorable one. It is probable that such therapy may sometimes postpone the outbreak of the disease (incubation period in the treated rabbits was occasionally up to seven weeks against a maximum of two weeks in the controls). But it is also probable that during this period the organisms continued to propagate and finally produced much more severe reactions than were shown by the untreated controls.

II. Relations of clinical results to cutaneous hypersensitivity

The cutaneous reactivity of all rabbits and the agglutination titers of their sera were determined immediately before inoculation of the eyes, at the end of the experiment when treatment was terminated, and just before the death of the rabbits. The results of these determinations were studied in relation to initial allergic reactions to the effect of hormonal therapy on the cutaneous reactions, to the relation of cutaneous reactivity to the incidence and severity of the ocular reactions, and to the histologic character of the ocular and systemic lesions. The details of these studies are as follows:

A. *Relation of cutaneous sensitivity to the allergic ocular reactions*

Since the initial allergic ocular reaction was completely or partially suppressed by all forms of hormonal therapy, the relationship of cutaneous hypersensitivity to the ocular allergic reaction could be studied only in the untreated control group. This study is shown in Table 4.

In six rabbits with high cutaneous hypersensitivity, the initial reaction was severe in five and slight in one animal. In one rabbit with a moderate degree of cutaneous hyper-

TABLE 4

Relation of cutaneous hypersensitivity to severity of initial ocular allergic reaction in 15 untreated control rabbits

Degree of Cutaneous Hypersensitivity	No. of Rabbits	Degree of Initial Ocular Allergic Reaction	
		High	Low
High Erythema 16 × 13+ with induration	6	5	1
Medium Erythema 6 × 6 mm.—15×12 mm. with moderate induration	1	1	0
Low Erythema—zero to 5 × 5 mm. with no or slight induration	8	5	3

TABLE 5

EFFECT OF HORMONAL THERAPY ON CUTANEOUS REACTIVITY

Type of Rabbit	Total Number	Sensitive at Beginning Insensitive at End	Sensitive at Beginning Sensitive at End	Insensitive at Beginning Insensitive at End
Untreated controls	15	2	8	5
Surviving treated rabbits (Groups II, III, IV, V)	37	22	6	9

sensitivity the initial allergic reaction was +1. In eight rabbits with a low or absent cutaneous reactivity, the initial allergic reactions were relatively high (+1 or greater) in five, and were low in three (a trace to 0.5). These results are of no statistical value. They indicate only a tendency to more severe ophthalmic allergic reactions in the highly hypersensitive animals, a result which would be expected.

B. *Suppression of cutaneous reactivity by hormonal therapy*

Hormonal therapy of all types, the parenteral administration of cortisone, hydrocortisone, corticotropin, and the topical administration of cortisone ointment had a definite suppressing effect on the cutaneous reactivity to Brucellergen.

Of the 15 untreated controls, 10 showed a well-marked cutaneous reactivity to Brucellergen at the beginning of the experiment, and five showed a low or absent reactivity. During the course of the experiment, the reactivity to Brucellergen faded spontaneously in only two of the hypersensitive rabbits, and, at the end of the experiment, eight animals still showed full or increased sensitivity while seven were negative.

There were 37 survivors among the treated rabbits at the end of the experiment. Before treatment was started, 28 of these animals were sensitive and nine insensitive. At the conclusion of the experiment the cutaneous reactivity to Brucellergen had completely disappeared in 22 of the previously sensitive rabbits while in the remaining six, the reactivity was greatly diminished. The nine animals, nonreactive at the beginning of the hormonal therapy, were still nonreactive at the end of the experiment. These results are shown in Table 5.

C. *Relationship of cutaneous reactivity to ocular and systemic lesions*

1. *Incidence.* There was no apparent relationship between the cutaneous reactivity to Brucellergen and the occurrence of either the ocular or systemic lesions. When all 68 test animals, controls and treated, were divided into three groups according to their initial hypersensitivity, and the incidence of major and minor ocular reactions and of systemic lesions was determined in the three groups, there was no statistical difference in the results. While hypersensitivity may influence the severity of the initial allergic reaction, it appears to have no influence on the causation of the actual organic granulomatous lesions of the disease.

2. *Severity.* When the relationship of cutaneous hypersensitivity to the severity of the ocular lesions was studied, no relationship could be found. Six of the major reactors showed a high sensitivity, three of medium sensitivity, and five a low or absent sensitivity. Six of the minor reactors showed a high sensitivity, three a medium sensitivity, and nine a low sensitivity. Hypersensitivity to Brucellergen did not appear to influence the course of a subsequent ocular brucellosis. These results are shown in Table 6.

D. *Histology*

When the eyes and tissues of the various rabbits used in these experiments were examined histologically, there was no demonstrable difference in the character of the le-

TABLE 6

RELATION OF OCULAR AND SYSTEMIC LESIONS TO CUTANEOUS HYPERSENSITIVITY

Degree of Cutaneous Hypersensitivity Groups I, II, III, IV and V.	No.	Ocular Reactions		Systemic Lesions
		Minor	Major	
High Erythema 15 by 12 mm.+ with induration	21	7	8	3
Medium Erythema 6 by 6 mm.—15 by 12 mm. with moderate induration	23	3	3	4
Low Erythema negative to 5 by 5 mm. with no or slight induration	24	10	7	7

sions found in the rabbits with high sensitivity and those with low sensitivity.

III. RELATIONSHIP OF IMMUNITY TO OCULAR AND SYSTEMIC LESIONS

The immunity acquired by the rabbits as the result of their previous systemic infection was almost certainly the factor responsible for the relatively low incidence of ocular infection. Previous experiments have shown that, when normal rabbits receive a comparable dose of organisms in the eye, there is a 100-percent incidence of severe ocular infections. It is also possible that some immune factor may be responsible for the extremely low incidence of the systemic granulomatous lesions. However, these lesions develop late in the course of the disease and it is possible that killing the animals as soon as six months after the intravenous inoculation may also be a factor.

The only materials in this experiment available for a study of the effect of immunity of the incidence of lesions are (a) the relations of ocular and systemic lesions to the agglutination titer and (b) an analysis of the incidence of generalized lesions (right and left eye lesions plus systemic lesions) in the reacting animals. These analyses are as follows:

A. *Relation of agglutinin titer to ocular and systemic lesions*

The agglutinin titer appeared to bear no relationship to the incidence of either the ocular or systemic lesions. The incidence of such lesions in relation to high, medium, and low agglutinin titers is shown in Table 7. With these small numbers, there is no statistical difference in the three groups. Likewise, the nonreacting animals, which had no ocular or systemic lesions, showed the same distribution in the intensity of the agglutinin titer.

Whatever humoral element may be responsible for immunity in brucellosis, it does not appear to be the agglutinin titer.

B. *Incidence of multiple lesions*

If multiple Brucella lesions, either bilateral

TABLE 7

RELATION OF OCULAR AND SYSTEMIC LESIONS TO AGGLUTININ TITERS

Degree of Agglutinin Titer	No.	Ocular Reactions		Systemic Lesions
		Minor	Major	
High (1:640+)	23	9	5	5
Medium (1:160–1:640)	20	7	4	5
Low (Neg.—1:80)	25	4	9	4

TABLE 8

INCIDENCE OF SINGLE AND MULTIPLE BRUCELLA LESIONS

	Right Eye (13 rabbits)		Left Eye (25 rabbits)		Systemic Lesions (14 rabbits)	
	Single Lesions	Multiple Lesions (Bilateral ocular or ocular systemic)	Single Lesions	Multiple Lesions (Bilateral ocular or ocular systemic)	Systemic Only	Systemic and Ocular
Untreated controls (I)	0	4	7	6*	0	4
Cortisone treated (II)	0	3	1	4	0	4
Hydrocortisone treated (III)	0	3	1	2	0	2
Corticotropin treated (IV)	0	1	2	1	0	1
Topical cortisone (V)	2	0	1	0	0	3
Totals	2*	11	12†	13	0	14

* No sections on two rabbits.
† No visceral sections on six rabbits.

ocular lesions or ocular lesions together with systemic lesions were the general rule in the reacting rabbits, while the rest of the rabbits remained entirely free of lesions, it would argue an undue susceptibility on the part of the reacting rabbits and a high immunity on the part of the nonreacting rabbits. Table 8 shows the incidence of multiple and single lesions in rabbits which either ocular or systemic lesions.

Thirteen rabbits showed either minor or major reactions in the right eye; 11 of these developed disease in the left eye, and six of these rabbits with bilateral ocular lesions also showed visceral lesions suggestive of early brucellosis. Only two rabbits with a Brucella infection in the right eye failed to show other probable lesions of the disease.

Fig. 1 (Wood, Becker, and Woods). Abscess in anterior chamber in advanced experimental ocular brucellosis.

There were 25 rabbits which developed major or minor infections in the left eyes. Thirteen of these rabbits showed other lesions—either in the right eye, in the viscera, or in both. Of the 12 rabbits that are recorded as having lesions in the left eye only, six died prematurely before the end of the experiment, and there were no visceral sections available for study.

The incidence of single lesions in these rabbits was chiefly in the controls and is probably due to the fact already discussed; that is, that these eyes had been made unduly susceptible to infection by the previous double allergic insult. Due to this extraneous factor, an analysis which includes the incidence of lesions in the left eye of the Group I rabbits is scarcely permissible.

There were 14 rabbits in the entire series who showed visceral lesions. In three rabbits the lesions appeared typically characteristic of brucellosis; in 11 it was impossible to say definitely whether the early changes observed were due to the Brucella infection or to some nonspecific cause. However, it is notable that all 14 of these rabbits developed definite ocu-

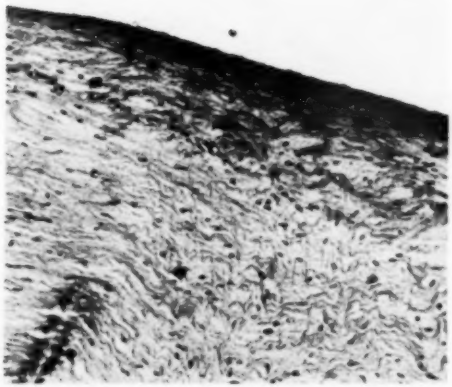

Fig. 2 (Wood, Becker, and Woods). Subepithelial infiltration and scarring in experimental ocular brucellosis.

lar Brucella lesions after inoculation of the eyes.

Summing this up, if the incidence of lesions in the left eye is not considered as a basis for conclusions, it appears that the great majority of reacting rabbits probably have multiple lesions of brucellosis and are unduly susceptible to the infection. It is a logical conclusion that these rabbits had acquired only a low degree of immunity from their previous Brucella infection, while the rabbits which failed to develop either ocular or systemic lesions had acquired a high immunity. It is also apparent from Table 8 that the hormone therapy played no role in the dissemination of the organism or the occurrence of multiple lesions.

It is unfortunate that opsonocytophagic indices were not done in these rabbits. Since it is clear that the agglutination titer is probably not concerned in the immunity to reinfection, it is quite possible that opsonic indices might have furnished the answer. All that can be said from the meager evidence available is that when the eyes of immune-allergic rabbits are inoculated in the anterior chambers with a standard inoculum, the later development of ocular lesions depends on the amount of immunity the animals had

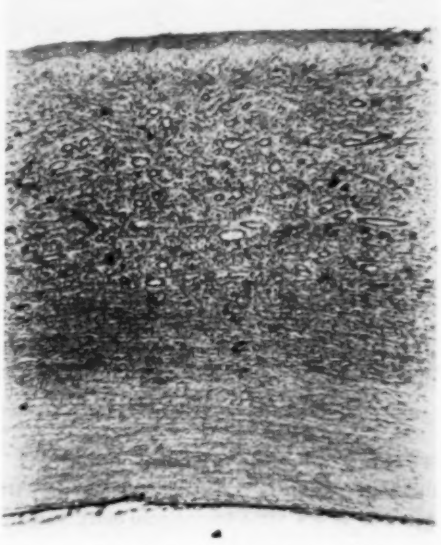

Fig. 3 (Wood, Becker, and Woods). Edema, cellular infiltration, and neovascularization of the cornea in experimental brucellosis.

acquired from the previous systemic infection.

C. Relation of lesion to bacterial invasion

At the time for autopsy, cultures for Brucella were taken from the uveal tract of

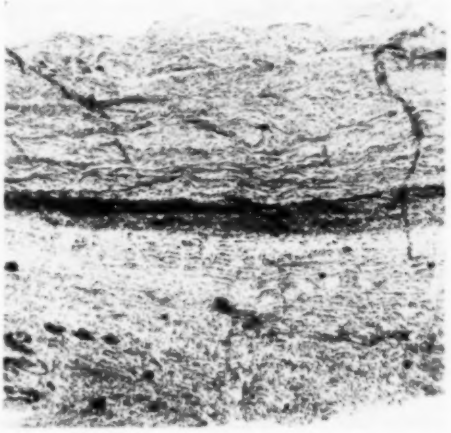

Fig. 4 (Wood, Becker, and Woods). Area of scleritis beneath an extraocular muscle in experimental ocular brucellosis.

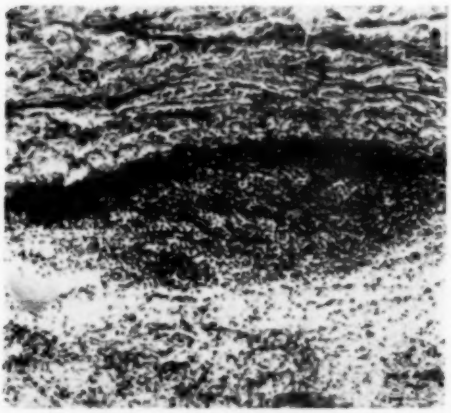

Fig. 5 (Wood, Becker, and Woods). Scleral nodule (high power).

Fig. 7 (Wood, Becker, and Woods). Early lesion of choroid.

the four clinically active eyes and from the aqueous of one such eye. These cultures were all positive. Unfortunately, cultures were not taken from the inactive eyes. Therefore, all that can be said is that under the conditions of this experiment the presence of the active ocular lesions of brucellosis were constantly associated with living organisms in the uveal tract or aqueous. It is quite possible that in the inactive eyes the organisms had been destroyed by the immunity present in the animals and cultures would have been sterile. But since cultures were not taken, this is only an assumption.

The joint fluid and joint tissue of one rabbit with arthritis both gave positive cultures. Positive cultures were also obtained from the viscera of the three animals showing probable Brucella lesions. In three other instances, positive cultures were obtained from apparently normal viscera (liver, kidney, and spleen). Blood cultures were done

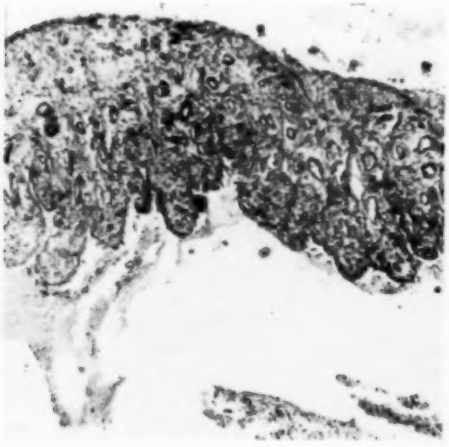

Fig. 6 (Wood, Becker, and Woods). Edema, capillary dilatation, and cellular infiltration of iris.

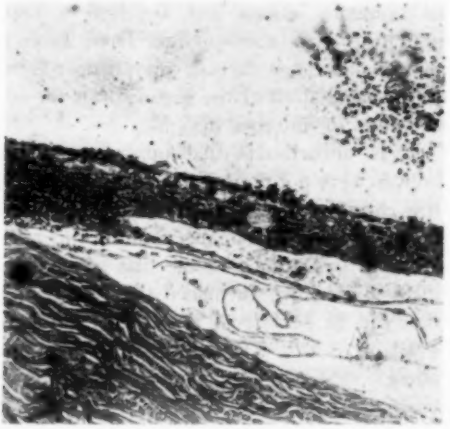

Fig. 8 (Wood, Becker, and Woods). Diffuse cellular infiltration of choroid.

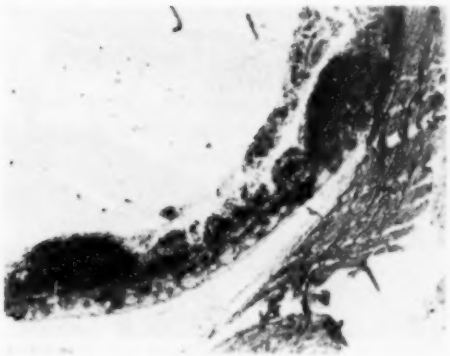

Fig. 9 (Wood, Becker, and Woods). Tuberculoid nodular lesion of choroid.

on two of these rabbits and both were negative. A positive blood stream infection therefore was not responsible for the positive tissue cultures in two of these three animals.

Blood cultures were done at the time of killing on all animals with an agglutinin titer of 1:640 or higher. These cultures were all negative. There was no evidence, therefore, of a persisting blood-stream infection in these animals.

IV. Pathology

A. Ocular

The control and treated rabbits both showed the same general pattern of histologic lesions. The usual picture was cellular infiltration with lymphocytes, polymorphonuclears, epithelioid cells, and plasma cells.

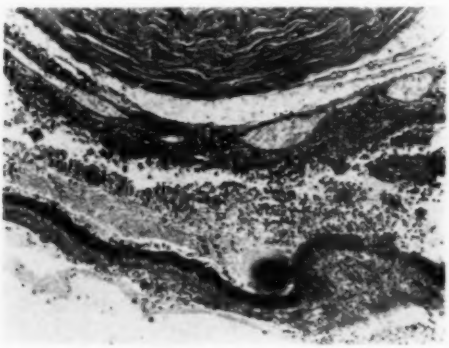

Fig. 10 (Wood, Becker, and Woods). Involvement of overlying retina from choroidal lesion.

Fig. 11 (Wood, Becker, and Woods). Endophthalmitis and exudates in vitreous in advanced severe experimental ocular brucellosis.

There was a definite tendency to nodular or tubercle formation. In the older lesions there was a fibroblastic reaction around the lesion with more or less encapsulation, giving the typical picture of a tuberculoid reaction.

In many of the more extensive lesions, polymorphonuclear cells appeared to predominate, giving the picture of a purulent reaction. In one advanced case there was an actual abscess in the anterior chamber (fig. 1). A similar predominance of polymorphonuclears had previously been observed by

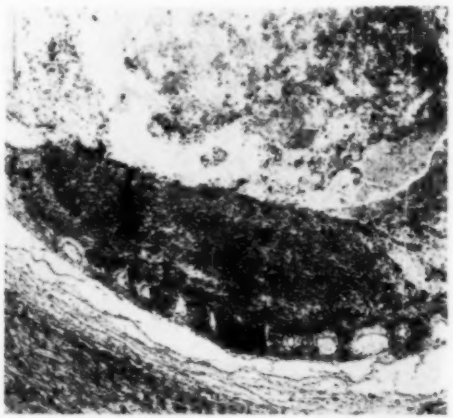

Fig. 12 (Wood, Becker, and Woods). Tuberculoid lesion of choroid with exudate beneath retina.

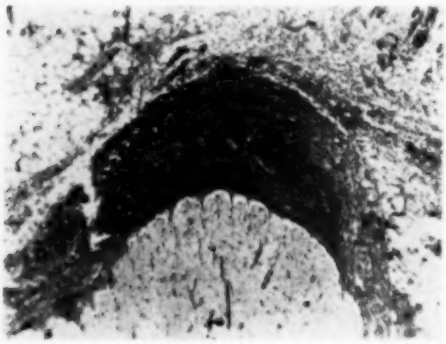

Fig. 13 (Wood, Becker, and Woods). Granulomatous tuberculoid lesion of meninges about optic nerve.

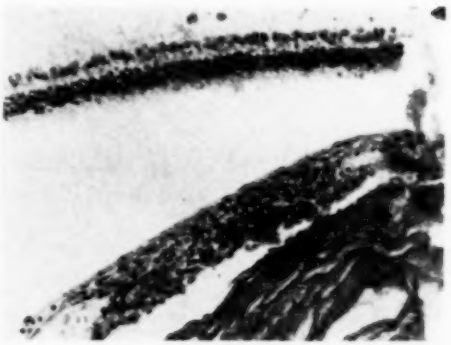

Fig. 15 (Wood, Becker, and Woods). Small choroidal lesion in asymptomatic eye in ocular brucellosis.

Burky[10] in his studies on experimental brucellosis in rabbits.

Cornea. In the cornea there were occasionally small localized subepithelial infiltrates (fig. 2) which probably represented the superficial nummular infiltrates seen clinically. There was frequently edema fluid between the lamellae of the stroma and new capillaries at the limbus, marking the peripheral vascularization. In more severe cases there was a diffuse cellular infiltration through the stroma with marked edema (fig. 3).

Sclera. One rabbit showed a beautiful area of scleritis immediately beneath an extraocular muscle (fig. 4). In one place this assumed a nodular appearance (fig. 5). This lesion was covered by the overlying muscle and was not observed clinically.

Uveal tract. The most marked lesions were in the uveal tract. The iris changes were as a rule confined to edema, capillary dilatation, and minor infiltration with wandering cells (fig. 6). In the choroid the early changes were small foci of cellular infiltration (fig. 7). In more advanced cases the infiltration of the choroid became more diffuse (fig. 8) with the same tendency to nodular formation or the tuberculoid type of reaction (fig. 9).

Retina. The overlying retina was frequently involved with a massive chorioretinitis (fig. 10) and in very advanced cases there were exudates in the vitreous, and endophthalmitis (fig. 11) with caseation and

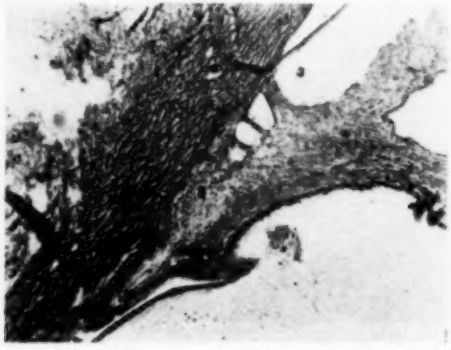

Fig. 14 (Wood, Becker, and Woods). Anterior synechias after "minor" reaction.

Fig. 16 (Wood, Becker, and Woods). Area of pleuritis in experimental brucellosis (low power).

necrosis. In the same eye there was an advanced tuberculoid reaction of the choroid with exudates beneath the retina (fig. 12).

One rabbit showed a beautiful encapsulated tuberculoid lesion in the meninges around the optic nerve (fig. 13). In the rabbits with clinically active disease at the time of death or killing, the cellular infiltration of the choroid and secondary retinal involvement were marked and of the tuberculoid type.

In the so-called minor reaction, there was a remarkable tendency to almost complete absorption of the lesions. In many rabbits which had recovered from these minor attacks, the only residual evidences of the former inflammation were a few persisting anterior synechias at the angle and a few wandering cells at the root of the iris (fig. 14). An occasional asymptomatic eye showed focal collections of lymphocytes in the choroid (fig. 15), either the residua of an old lesion or a very early lesion.

B. Systemic lesions

At the conclusion of the experiment in June, 1952, there were 53 surviving rabbits in all groups. These rabbits had been inoculated intravenously on December 7, 1951, and their systemic infection was therefore of six months' duration.

There were amazingly few macroscopic or microscopic lesions in the viscera of these rabbits. A few rabbits showed evidences of pleuritis, one a large abscess of the uterus, and one an effusion in a knee joint.

In only three rabbits were typical granulomatous lesions found, which were characteristic of a Brucella infection.

One rabbit showed a pleuritis (figs. 16 and

Fig. 18 (Wood, Becker, and Woods). Tuberculoid lesion of pleura in experimental brucellosis.

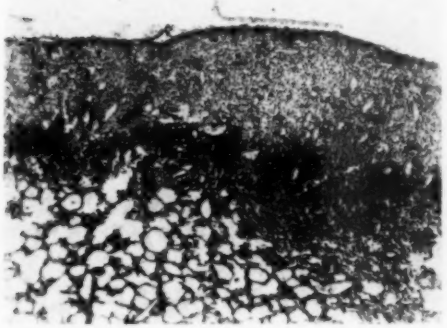

Fig. 17 (Wood, Becker, and Woods). Area of pleuritis in experimental brucellosis (high power).

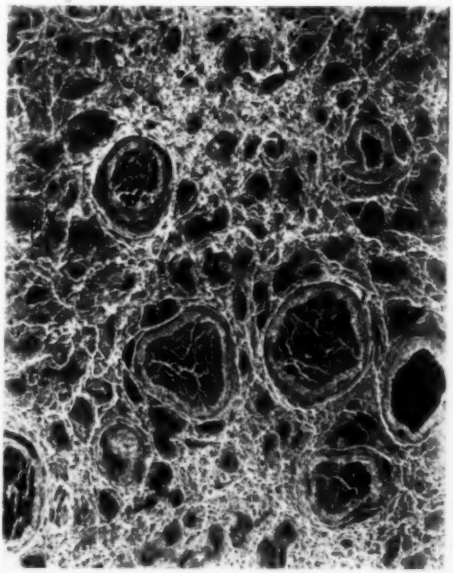

Fig. 19 (Wood, Becker, and Woods). Tuberculoid lesions in spleen in experimental brucellosis.

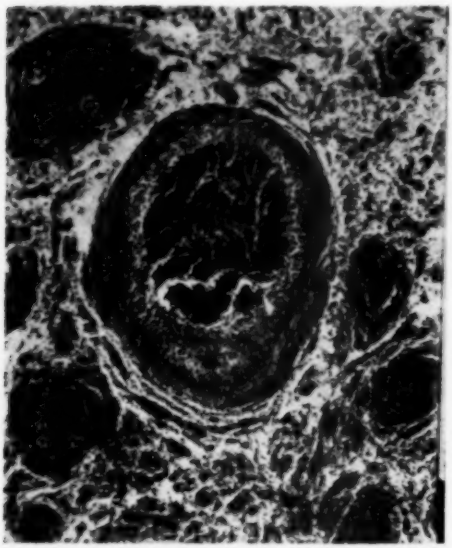

Fig. 20 (Wood, Becker, and Woods). Tuberculoid lesion in spleen (high power).

17) with a small adjacent area of a typical tuberculoid reaction (fig. 18).

A second rabbit showed almost classical encapsulated tubercles with necrotic centers in the spleen (figs. 19 and 20). In these lesions and in the advanced tuberculoid ocular lesions, there was a predominance of polymorphonuclear leukocytes.

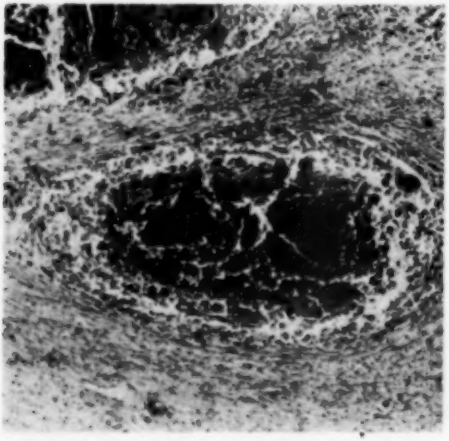

Fig. 21 (Wood, Becker, and Woods). Necrotic tuberculoid lesion of uterine wall in experimental brucellosis.

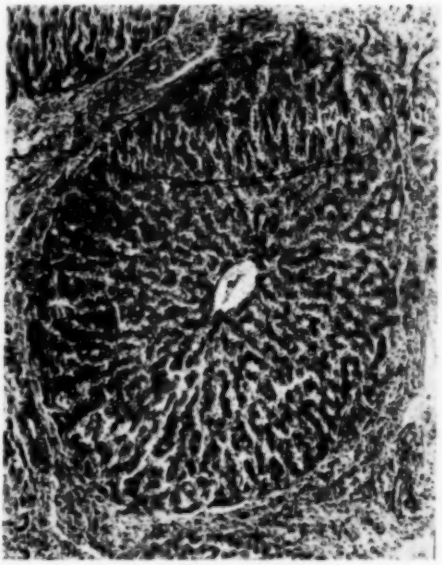

Fig. 22 (Wood, Becker, and Woods). Perilobular fibrosis and cellular infiltration (liver) in experimental brucellosis.

A third rabbit showed a large necrotic abscess in the uterus and in the uterine wall there were several tuberculoidlike masses (fig. 21) more or less encapsulated, with necrotic centers and many polymorphonuclear leukocytes.

A number of rabbits showed areas of

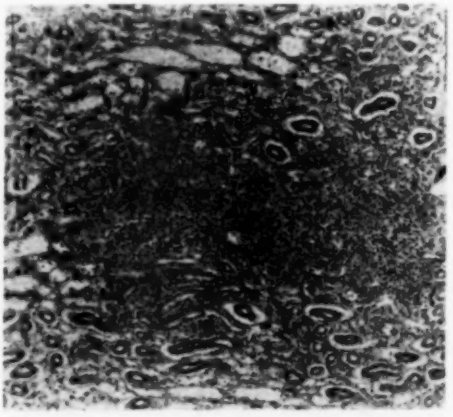

Fig. 23 (Wood, Becker, and Woods). Local area of cellular infiltration of kidney in experimental brucellosis.

cellular infiltration and scarring in the liver and kidney (figs. 22 and 23). However, since somewhat similar lesions are often found in the viscera of apparently normal adult rabbits and may arise from various infections it was impossible to attribute these directly to brucellosis.

Comment

The incidence, character, and course of the clinical lesions have already been described and need no further comment. The most interesting observations in this experiment were the slight influence hypersensitivity played in determining the pattern of the lesions, the important role played by the acquired immunity, and the effect or lack of beneficial effect of adrenal cortical hormone therapy on the granulomatous ocular lesions of brucellosis.

The suppression of the ophthalmic allergic reaction and the cutaneous reactivity to Brucellergen are exactly what would have been expected and are quite in line with the numerous other observations of the effect of adrenal hormonal therapy on the hypersensitive reaction.

The peculiar finding was that the acquired hypersensitivity, as manifested by the cutaneous reactivity to Brucellergen, apparently did not influence the lesions resulting from later inoculation.

In tuberculosis, within certain limits, hypersensitivity to tuberculo-protein is the dominant factor in determining the course of the tuberculous lesion, being responsible for the acute inflammation and largely concerned in the destructive phases of the tuberculous lesions.

This did not appear to be the case with brucellosis under the conditions of this experiment.

The general clinical and histologic pattern of the Brucella lesions was essentially the same in the hypersensitive and insensitive controls, and in the treated rabbits in which the hypersensitive reaction was suppressed by the hormonal therapy. Specific bacterial hypersensitivity appeared to have only a minor or negligible influence on the causation or course of a Brucella uveitis.

The essential factor responsible for the development of both ocular and systemic lesions appears to be the growth and spread of living organisms in the tissues. In all eyes and tissues with active clinical disease, cultures disclosed the presence of living Brucella organisms, and the conclusion appears inescapable that the growth and spread of the living organisms in the tissues was responsible for the lesions.

The increased resistance or immunity acquired as a result of the previous systemic infection must be the factor which encompasses the destruction of the bacilli and is responsible for the low incidence of ocular and systemic lesions. In the normal nonimmune animal, a similar dose of bacilli in the eye uniformly results in a rapidly destructive disease.

Acquired immunity is developed in varying degrees by different animals. In some animals with high immunity, the injected organisms are promptly destroyed; in others, the battle between resistance and infection is more even, the organisms finally being destroyed but not until they have caused some tissue reaction; in still others, the resistance is finally overwhelmed by the invading bacilli, and chronic infection ensues. This appears to have been the case in the various rabbits used in this experiment.

With the exception of a preceding hormonal therapy possibly lessening the incidence of minor reactions in the left eyes of the treated rabbits, and probably increasing the intensity and prolonging the duration of severe reactions, hormonal therapy appears to have had little if any effect on the lesions.

This is indeed what might be expected from what is known of the inhibiting effect of the adrenal cortex on inflammation.

This inhibitory action is only relative, and in the presence of a massive infection is overwhelmed. Therefore, it is quite possible that the inhibition of preceding minor inflamma-

tion, with the resultant absence of mobilization of inflammatory cells, may render the animals defenseless when the acquired immunity was insufficient to destroy the organisms. A preceding 19 days' hormonal therapy did not alter the immunity, for the incidence of infectious reactions was the same in both the right and left eyes. As already outlined, the preceding double allergic trauma in the left eyes of the untreated controls was also probably a factor in the increased incidence of infectious reactions in these eyes.

How hormonal therapy influenced the intensity and duration of the severe reactions is not altogether clear. For want of a better explanation, it is supposed that through some not-understood mechanism, the adrenal cortex hormones place a shield between the cells and the noxious agent. They do not affect the propagation or growth of bacteria.

It is probable that, in this instance, the hormonal therapy gave some temporary protection to the tissue cells which resulted in the variable lengthening of the incubation period. But in the presence of a low immunity, the organism continued to propagate in the eyes, soon overcame the weak protective action of the hormones, and in the presence of a crumbling defense and a massive inoculum, produced severe symptoms of long duration.

Whatever may be the actual explanation, one fact is clear—that therapy with the adrenal cortex hormones did not have a favorable effect on this experimental granulomatous uveitis produced in immune-allergic rabbits by inoculation of the eyes with Brucella organisms.

Conclusions

Under the conditions of this experiment, the following conclusions appear justified.

1. In Brucella immune-allergic rabbits the parenteral treatment with cortisone, hydrocortisone, and topical treatment with cortisone, suppressed either completely or partially the initial allergic reaction in secondarily infected eyes, and likewise suppressed the cutaneous reactivity to Brucellergen.

2. There was no evidence that hormonal therapy had any favorable effect in these rabbits with an experimental Brucella uveitis, other than a possible inhibition of minor inflammation in the eyes of animals which had received 19 days' hormonal therapy before inoculation of the eyes.

3. In the eyes in which severe infection developed the hormonal therapy apparently increased the severity and duration of the final disease.

4. Neither systemic hypersensitivity to Brucellergen nor circulating agglutinins in the blood plasma appear to play any role in the causation of the ocular lesions or influence the course of the disease. The one factor determining the outbreak of ocular lesions appeared to be the immunity acquired by the previous systemic infection.

5. The clinical and histologic lesions of this granulomatous Brucella uveitis were constantly associated with the presence of living organisms in the eye.

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PATHOGENESIS OF EXOPHTHALMOS*

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Exophthalmos is a manifestation of either a local or a systemic disorder and the determination of the cause may lead to considerations and techniques common in practically all branches of medicine. The differential diagnosis may be lengthy and difficult, and often an accurate diagnosis is impossible. Repeated observations as the case progresses are of value in helping to establish the true cause.

ETIOLOGY

There are six main categories of orbital disorders:

1. Developmental anomalies
2. Vascular lesions
3. Trauma
4. Inflammations
5. Neoplasms
6. Endocrine dysfunctions

Within these categories there are reported more than 75 different causes. The following 10 conditions comprise more than 90 percent of the total number encountered:

1. Endocrine dysfunctions
2. Hemangiomas and aneurysms
3. Meningiomas
4. Dermoids
5. Chronic granulomas
6. Lymphomatous disease
7. Mixed tumor of the lacrimal gland
8. Glioma of the optic nerve
9. Extension of infection or tumor from the paranasal sinuses
10. Peripheral nerve tumors within the orbit.

DIAGNOSTIC METHODS

A thorough and careful history of the onset and the development may appreciably reduce the number of technical studies one might otherwise blindly undertake and thus direct the course of investigation along more limited channels.

The physical diagnostic measures employed entail a complete general examination with special emphasis upon the orbit and surrounding structures.

Occasionally a mass may be palpated along the orbital rim or one may note indirect evidences of a space-occupying lesion such as displacement of the globe, disturbances of the retinal vessels, wrinkling of the retina, papilledema, or optic atrophy.

Relaxation is important when palpating for a tumor and when necessary general anesthesia may be used. In addition to palpation with the examining finger, a glass rod may be used. In this way small protuberances can be noted which might otherwise be missed.

Inflammatory manifestations such as localized redness, tenderness, and edema of the conjunctiva and lids point to an infectious process, whereas gradual vascular congestion, limitation of motility, and lack of compressibility of the globe indicate more of an endocrine influence.

Accurate measurements of progression are possible by use of the Hertel exophthalmometer. Often gross resistance to compression can be registered by digital examination or more accurately by orbitonometry.[1] Visual acuity changes, visual field defects, disturbances of motility, and gross bony asym-

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Fig. 1 (Reeh and Singer). Thyrotoxic type of exophthalmos in a woman, aged 30 years. Hertel exophthalmometer measurement, 15 mm.

metries are important signs.

Many valuable laboratory procedures include blood, urine, and spinal-fluid studies, as well as determination of basal metabolism rate, protein-bound iodine, and radioactive iodine uptake in cases of endocrine disorders.

A biopsy may be of value but the surgeon must be ever mindful of its limitations and dangers. Inadvertently one might enter a large aneurysm or disturb a reasonably well-encapsulated malignant tumor. In general,[2] when a biopsy is made, the surgeon should be prepared to do an extensive excision or care for all complications which may arise.

The most valuable diagnostic aid has proven to be X-ray studies. Pfeiffer,[3] reporting on 200 cases of exophthalmos, noted some positive X-ray evidence in 42 percent of his cases. Other useful X-ray techniques include arteriography, introduction of air into Tenon's space, and roentgen tomography.[4]

The X-ray changes most commonly noted are: (1) Increased soft tissue density and presence of calcification, (2) evidence of increased intraorbital pressure, (3) fossa formation or induration of bone, (4) presence of dehiscences, (5) invasion and erosions of the bone (6) hyperostosis, and (7) deformity of the optic foramen.

Ten most common causes of exophthalmos

1. Endocrine dysfunctions

There has been an ever increasing effort to differentiate the exophthalmos due to endocrine influences into one type associated with thyrotoxicosis, and another related to combined thyroid and pituitary dysfunctions.

The thyrotoxic type (fig. 1), most common in young adult women, is more of an apparent than a real exophthalmos. This is due to the widened palpebral fissures and stare.

The apparent exophthalmos is always bilateral and associated with lid lag, globe lag, and infrequent blinking. The globe can be pressed back into the orbit easily and the apparent exophthalmos recedes under proper medical or surgical therapy. Even if the case terminates fatally, the exophthalmos may disappear postmortem.[15]

Widening of the palpebral fissures is believed to be due to contraction of Müller's and Landstrom's muscles under the influence of stimulation of the cervical sympathetics. How the overactive thyroid stimulates the cervical sympathetics is unknown[14] but experimental stimulation of this structure either electrically, by injection of cyanides, or by administration of thyroxin will produce a similar type of exophthalmos.[5]

There is no chronic orbital infiltration or

Fig. 2 (Reeh and Singer). Thyrotropic type of exophthalmos in a man, aged 46 years. Hertel exophthalmometer measurement, 23 mm.

edema of the lids and conjunctiva. There may be gradual wasting and degeneration of the muscles and nerves.

The thyrotropic type (fig. 2), occurring most frequently in middle-aged males, represents a true exophthalmos. Early there is edema of the lids and conjunctiva, vascular congestion, and diplopia due to muscle palsies. With progression the congestion and immobility increases, the globe cannot be pressed into the orbit, and corneal ulceration and even perforation may occur due to exposure. However, the progression may cease at any stage and spontaneous recession may occur. Often the exophthalmos is unilateral in the beginning.

Mulvaney[9] believes that in these cases a normal check and balance between the thyroid and pituitary is disturbed by decreased thyroid activity. With the normally inhibiting thyroid influences withdrawn, the pituitary thyrotropic hormone is produced in excessive amounts. This results in the pathologic changes which are found in thyrotropic exophthalmos.

The pathologic changes consist of congestion, edema, and abundant round cell infiltration into the orbital tissues. There is a special degeneration of the tissues (like a fatty degeneration) with subsequent fibrosis. The orbital fat is either of normal amount or reduced and the muscles are tremendously enlarged. The more advanced the fibrosis, the more irreversible becomes the exophthalmos.

Smelser[6] has been able to produce similar exophthalmos with like pathologic changes by injection of the thyrotropic hormones into mice, and Dobyns[7] similarly in guinea pigs. The exophthalmos can be diminished by the administration of thyroxin or one of the estrogens.[8]

The theoretical explanation of the pathophysiology seems inadequate in those cases of thyrotropic exophthalmos associated with hyperthyroidism, or with a normally functioning thyroid gland.[10] Some investigators[16] believe there may be an unknown exophthalmic factor closely associated with the thyrotropic hormone in pituitary extract which is actually the causative agent. Further investigation is necessary to eliminate the confusion which now exists.

2. Hemangiomas and aneurysms

Hemangiomas and aneurysms occur rather commonly in the orbit and may be congenital or traumatic. The congenital hemangiomas may appear during infancy or during middle life. They may be located anywhere in the orbit but their most common location is in the upper nasal quadrant.[11] An intermittent type of exophthalmos with discoloration of the lids may occur when there is breakdown of the vascular channels with reformation of new ones. The proptosed eye is readily pressed back into the orbit and at times a soft mass may be palpated. Bony changes may be demonstrated by X-ray studies.

Arteriovenous aneurysms may be congenital or traumatic. The congenital type becomes manifest usually in the third or fourth decade while the traumatic variety follows an injury. The aneurysm may occur in the orbit but more often is due to a communication between the carotid artery and the cavernous sinus. Following trauma there may be a rapidly developing exophthalmos. The patient may experience head noises synchronous with his heart beat, and the examiner may be able to elicit a bruit.

In the presurgical evaluation of hemangiomas and aneurysms, it is important to determine, if possible, the exact location, the size, and the vascular supply. Failure to appreciate these factors preoperatively may result in severe and even fatal hemorrhage during surgery.

3. Dermoid

The dermoid represents a benign tumor which has developed from an embryonic rest of ectodermal cells. It may be cystic or solid or a combination of the two depending on the nature of the growth of the cells. The exophthalmos, which is unilateral, may ap-

pear in childhood or in later life due to the slowness of its growth. There may or may not be disturbances in visual acuity, motility, or changes in the orbit visible by X rays. There may be a foreign-body type of inflammatory reaction due to the substances within the dermoid.

4. Meningioma

The meningioma tends to appear during middle life frequently arising as an intracranial growth invading the orbit secondarily. The meningiomas which cause exophthalmos tend to arise from the optic-nerve sheath, in the region of the optic foramen, or form the inner portion of the lesser wing of the sphenoid. In their growth they may pass directly through the fissures or through the bone itself.

The most common X-ray change is hyperostosis. In general the presence of hyperostosis in individuals below the age of 30 years is usually due to congenital exostosis and in cases over 30 years are more commonly associated with a meningioma. Because of the intracranial origin of this tumor neurosurgical assistance may be required.

5. Granuloma

The granuloma is one of the most common causes of exophthalmos. It may be due to tuberculosis, Boeck's sarcoid, syphilis, tularemia, fungi, a granulomatous type of Hodgkin's disease, or the inflammatory pseudotumor.

The inflammatory pseudotumor which is most commonly encountered occurs mainly in the middle-aged female. It may be associated with some congestion and slight pain upon ocular movements. It usually appears first in one eye followed at a later date in the opposite eye and may vary from a mild to a severe process.

The usual course is that of slow progression, but occasionally it may be rapid in its development. The extent of the exophthalmos may be severe enough to require lid adhesions or even orbital decompression.

Generally, the tendency is for spontaneous improvement, with at times complete recovery without loss of visual acuity or disturbances in ocular motility. The severe cases may, however, progress to complete fixation of the globe, loss of visual acuity, and even exposure keratitis.

The pathologic change consists of a productive type of inflammation of the orbital tissues manifest by lymphocytic infiltration with lymphatic follicles which may or may not have small characteristic capillary sinuses within them, and collagenous connective tissue in various stages of maturity. Its differentiation from a true tumor is essential to avoid unnecessary surgery.

6. Lymphomatous diseases

Reese[12] states that the lymphomatous tumors comprise a rather loosely knit group of lesions which may be entirely localized at one site, may show multiple sites anywhere over the body, and may involve the blood stream. The tumor may arise from any of the lymphoid sites over the body, nodal or extranodal, or it may also arise from sites where no known lymphoid tissue exists.

The point of importance in this condition is the realization of the wide variations of the disease. For that reason the mere presence of tissue which may suggest a lymphomatous tumor, either benign or malignant, should require immediate and periodic examinations of the patient to rule out the presence of more widespread involvement. Although the orbit may be the primary site, it may also reflect a more widespread dissemination of the disease.

The presence of this tumor will require careful and intelligent evaluation by the ophthalmologist after he has obtained adequate consultation.

7. Mixed tumor of the lacrimal gland

The mixed tumor of the lacrimal gland which is believed to develop from an embryonic rest of cells has been so designated because of its extreme variability and the

presence of other than ectodermal elements. It may vary from a highly malignant epithelial tumor to one where there are small islands of epithelial cells surrounded by a vast amount of mesodermal tissue in the form of connective tissue, cartilage, and even bone.

In the past, this tumor has been regarded as benign but experience has shown a reasonably high rate of recurrence following surgical removal. Ultimate death resulting from metastases of the tumor following surgical removal has not been uncommon. Sanders[12] reported 12 cases in which three patients had obtained a satisfactory result, five were dead, and four were living with recurrences following surgery.

It is believed that the presence of this tumor is an indication for careful and thorough removal the first time. Its apparent capsule, as well as bone which may be involved, should be completely removed. Failure to do this may result in recurrence of the tumor in a more malignant form.

8. Glioma of the optic nerve

Gliomas of the optic nerve occur in children usually under the age of 10 years. They occur about twice as frequently in females as in males.[11] They are slow growing, are associated with loss of vision and axial type of exophthalmos. The fundus may show papilledema with venous engorgement, and wrinkling of the retina. Motility may be little affected. An optic atrophy occurs and in time the X-ray film discloses an enlargement of the optic foramen.

9. Extension of infection or tumor from the paranasal sinuses

Exophthalmos is commonly caused by extension of infection from the paranasal sinuses. Dehiscences in the ethmoid sinuses may aid materially in the passage of infection. There may result a cellulitis, periostitis, osteomyelitis, or a frank abscess in the orbital tissues.

Tumors may extend from the paranasal sinuses into the orbit. The congenital exostosis which develops more often from the frontal sinus tends to appear in young individuals, whereas carcinomas are prone to appear in elderly individuals arising usually in the maxillary sinus.

Because of these possibilities each case of exophthalmos under observation should be studied by a qualified otolaryngologist.

10. Peripheral nerve tumors within the orbit

A peripheral nerve tumor arising from a sensory nerve branch within the orbit may cause exophthalmos. These tumors are nearly all benign and are probably a variant of the neurofibroma. Various names have been given to these tumors depending upon their histologic characteristics.

These tumors may or may not be associated with generalized manifestations of neurofibromatosis (von Recklinghausen's disease). There may be associated local changes such as pigmentation of the overlying skin, presence of nevi, or erosion of the bone.

In general, these tumors are slow growing and usually lend themselves reasonably well to surgical removal.

Therapy

Once the underlying cause has been determined, treatment resolves itself into medical, surgical, or both.

In the cases of thyrotoxicosis the therapy is directed toward the reduction of thyroid activity by the administration of iodine or various thyroid-depressing drugs.

In the cases of thyrotropic exophthalmos, medical therapy is difficult to evaluate because many cases undergo spontaneous recovery, and many others are treated when the exophthalmos has reached an irreversible state.

Administration of thyroid extract after suppression of any existing thyrotoxicosis is of value. The amount of thyroid administered must be gauged by the clinical re-

sponse. X-ray therapy is of value but should be reserved for the more severe cases. Undesirable side effects do result because of suppression of all pituitary functions. Electrocauterization has been mentioned; however, it seems an extremely radical procedure. Estrin and related products have been reported of some value in inhibiting the thyrotropic hormone output from the pituitary.

Surgery in exophthalmos is directed toward the following:

1. Protection of the eye.
2. Drainage of an abscess.
3. Removal of a tumor.
4. Cosmetic improvement.

In the development of exophthalmos it is extremely important to recognize early the need for adequate protection of the cornea. Too often corneal damage occurs before surgical measures are instituted.

Suturing of the lids is rarely adequate because of the short period of effectiveness. For this reason intermarginal lid adhesions are the most satisfactory. Once created they can be left in place for long periods of time, and separated when they have served their purpose. When intermarginal adhesions are inadequate an orbital decompression becomes necessary.

Surgical procedures have been developed whereby any one of the four walls of the orbit may be removed to increase the volume of the orbit and permit recession of the globe. The most satisfactory procedures are either the lateral or the transfrontal approaches.

The lateral approach is more simple and less dangerous than the transfrontal operation but may not give as good a result. The most effective procedure combines removal of a portion of the lateral wall with removal of the roof. The transfrontal approach presents two principal disadvantages, namely, a higher mortality and a tendency for disturbing pulsations of the brain transmitted to the globe.

Both the lateral and transfrontal approaches have also been used satisfactorily for the removal of tumors. These surgical procedures give the best exposure to the orbit. Their selection depends upon the origin and type of tumor, location, and blood supply. Other approaches such as the supraorbital, infraorbital, and transconjunctival have definite limitations.

As a general rule, these techniques should be utilized only for the removal of tumors located in the anterior portion of the orbit. Drainage of abscesses should be made through areas least likely to produce damage to ocular or extraocular structures such as the levator palpebrae, trochlea, superior oblique tendon, or orbital fascia.

Conclusion

Exophthalmos, existing alone or in association with disturbances in motility or loss of vision, may be due to a wide variety of causes.

Establishment of a diagnosis may require extensive investigations and possibly prolonged observations. An understanding of the orbit and its neighboring structures is essential. A knowledge of the principal pathologic lesions which produce the large majority of cases is an invaluable basis upon which to conduct the investigation.

A thorough physical examination combined with widely chosen laboratory and X-ray studies must be employed. Every effort must be made to establish a correct diagnosis.

The orbit does not tolerate indiscriminate exploratory surgery. One should never enter the orbit surgically unless a tumor can be demonstrated, or when reasonably positive evidence exists that one is present.

Careful evaluation of the nature, origin, and extent of the pathologic process is essential before deciding upon a surgical procedure. This must then be balanced against such factors as skill of the operator, equip-

ment and assistance available, and the physical condition of the patient.

One should never forget that an ill-chosen or improperly performed operation upon the orbit may cause more harm to the patient than would have resulted from the disease itself.

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THE OCULAR CHANGES IN THYROTROPIC EXOPHTHALMOS*

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Thyrotropic exophthalmos, a term popularized by Mulvaney,[1] denotes a protrusion of the eyes due to increased production of the thyrotropic hormone which is elaborated by the anterior pituitary gland. In this paper, in which the ocular changes in this condition are discussed, it is recognized that the term thyrotropic exophthalmos is perhaps misleading; but it does have wide usage in the literature.

The term leaves much to be desired, since the relationship of thyrotropic hormone to exophthalmos is not accurately defined, and recent evidence suggests that this hormone may not be the sole responsibile agent in this condition. Nevertheless, the term serves to convey the impression of a relatively uncommon condition associated with Graves' disease—a disease characterized by varying degrees of exophthalmos, palsies of the extraocular muscles, and orbital swelling. These symptoms, in the rare case, may progress to the point where drastic measures of a surgical nature are necessary to save the globes.

It would be well to keep in mind that

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Graves' disease, as a whole, is poorly understood and is by no means merely a thyroid disease. The disorder of the thyroid is but one item in the widespread endocrine imbalance caused by this disease. Other endocrine systems are involved as well as those of the eyes and the muscular, nervous, reticulo-endothelial, and lymphatic systems.

Most clinicians, and ophthalmologists in particular, are keenly aware that the ocular changes in the Graves' disease contribute an important diagnostic service. In four percent of the cases, however, the ocular changes may be maximum and, so, overshadow the general systemic signs of thyrotoxicosis. These cases are termed "thyrotropic" by Mulvaney[1] and are approximately equivalent to the "ophthalmic type" described by Rundles and Wilson[2] or to the "exophthalmic ophthalmoplegia" described by Brain.[3] The treatment of these rare cases is most difficult and instead of being just another diagnostic sign of Graves' disease, the eyes often present the primary problem.

Before my series of cases is reported, a brief review of the pertinent experimental, pathologic, and clinical data concerning thyrotropic exophthalmos would seem appropriate.

Review of experimental studies

Since the work of Schockaert in 1931,[4] it has been known that anterior pituitary extract is capable of producing an exophthalmos in the experimental animal similar to that seen in man. The guinea pig, the animal most frequently used, responds to the injections of whole anterior pituitary extract by showing protrusion of the globes, both in intact and thyroidectomized animals.[5] In an effort to find the causative agent, the relationship of the thyroid gland to the pituitary was considered; further studies with the thyrotropic fraction of the anterior pituitary followed.

It seemed possible that this hormone, independent of its stimulating action on the thyroid, was capable of producing exophthalmos. Smelser[6] demonstrated the exophthalmic property of the thyrotropic hormone and confirmed that thyroidectomy enhanced the exophthalmos induced in the guinea pigs so injected. He concluded[7] that the protrusion of the globes was due to an actual increase of 34 percent in the orbital contents of the injected guinea pigs, as compared with the control group. This increase was due primarily to an accumulation of edematous fat. This hypertrophy of retrobulbar connective tissue, fat, and muscles was similar to that seen in humans.

Dobyns[8] compared the exophthalmic properties of various thyrotropic preparations. He found that a purified thyrotropic hormone was incapable of producing an exophthalmos, in sharp contrast to cruder preparations which still possessed the exophthalmic property.

This suggested that the anterior pituitary elaborated a specific exophthalmic factor, independent of the thyrotropic hormone, which was lost in the purification of the hormone. The animals treated with the crude pituitary extracts showed a rapid mobilization of fat and deposition of this fat in liver, skeletal, cardiac muscles, and other sites.[9] Jefferies[10] iodinated anterior pituitary extract, which inactivated 95 percent of the thyrotropic hormone; yet this extract was still capable of evoking an exophthalmic response when injected into the experimental animal.

The finding of a specific exophthalmic factor produced by the pituitary could explain the variation of ocular changes found in Graves' disease when the eye signs and the thyrotoxicosis are widely disproportionate. Though no one, as yet, has succeeded in isolating an exophthalmic factor from the pituitary independent of the thyrotropic hormone, the evidence suggests its presence. The ultimate answer, in large part, will depend on the ability of the biochemist to fractionate the various components of the anterior pituitary—if this be possible.

The gonads (frequently) and the adrenals

occasionally) have been suspected in the pathogenesis of exophthalmos. The investigations of Dobyns,[8] Smelser,[11] and others[12] make it seem improbable that these other endocrine products are involved in the production of exophthalmos, at least in the experimental animal. The gonads have been mentioned as playing at least an auxiliary role in exophthalmos, primarily because the extreme cases are found more frequently in males in the middle-age group. This would suggest some gonadal factor.

Review of pathologic studies

A monumental study on human material was carried out by Rundles and Pochin,[13] in support of the experimental evidence pointing to an increase in the orbital contents as an etiologic factor in exophthalmos. They performed at autopsy, in 17 cases of Graves' disease, complete dissections of the orbits, followed by quantitative chemical analysis. The significant finding was an increase in orbital fat, including infiltration of the ocular muscles, the levator palpebras being most affected. The increase in the fat component of the orbit was present in all cases; however, the greatest increase was found in those cases in which exophthalmos was present before death and was proportional to the degree of exophthalmos. They concluded that this was the local etiologic agent in exophthalmos associated with Graves' disease.

Naffziger[14] and others have reported in detail on the pathologic findings in biopsy fragments obtained from humans during decompression surgery. Microscopically, the extraocular muscles showed edema with destruction of the muscle fibers. The muscle architecture was lost. Interstitial fibrosis and round-cell infiltration were present.

At surgery the outstanding feature was the finding of huge, edematous extraocular muscles, four to eight times normal size, and an associated marked edema of the orbital tissues.

Although they represent two different views, which are, however, not wholly incompatible, these reports on human material give a clue to the underlying orbital pathology.

One, that of Rundles and Pochin,[13] is based on the sole conclusion that increased fat content in the orbit is the basic factor in exophthalmos. The other, that of Naffziger,[14] considers edema as the important cause.

Means[15] points out that the autopsy cases of Rundles did not represent cases of malignant exophthalmos. It would seem that Naffziger's cases were all advanced or they would not have come to surgery.

Experimentally, these views can be compromised since Smelser considered both water and fat as the important factors producing exophthalmos in the experimental animal. Possibly there is first an increase in orbital fat which upsets the delicate circulatory balance. This in turn would raise the intraorbital pressure. Certainly the papilledema occasionally seen in this condition would indicate a venous stasis.

Terplan[16] and others report the pathologic findings on a far-advanced case of exophthalmos which ended in death. The case is included in this series. Pathologically, the cause of death was due to subacute diffuse myocarditis with subacute generalized myositis.

The myositis was characterized by extensive muscle-fiber necrosis involving most of the skeletal musculature. The heart and extraocular muscles were most severely involved. The inflammatory infiltration included many eosinophils, lymphocytes, and macrophages.

While myocarditis and myositis are known to occur in thyrotoxicosis and malignant exophthalmos, in general these conditions are reported as producing only slight to moderate changes characterized by focal degeneration, necrosis of muscle fibers, focal lymphocytic infiltration, and interstitial edema. The changes in Terplan's case differ, quantitatively, in that severity is more marked than in those reported by the other authors and qualitatively, by the marked eosinophilia.

These differences, although they cause one to doubt the presumption that the muscle changes are part of the original disease, certainly do not preclude this possibility.

Clinical description

Clinically, five outstanding ocular changes occur in thyrotropic exophthalmos, usually, but by no means always, in the following sequence: exophthalmos, lid retraction as a result of exophthalmos, extraocular muscle palsies, orbital swelling, and papilledema.

Exophthalmos has proven to be just as elusive a problem clinically as experimentally. When it is considered as one entity, the problem of exophthalmos is difficult enough. It is complicated further by the possibility that two distinct types of exophthalmos may be encountered in Graves' disease. This dualistic viewpoint, conceived by Mulvaney,[1] is supported by many ophthalmologists.

Mulvaney[1] considers that the exophthalmos, indeed all the ocular changes, represent two distinct pathologic and clinical entities. The question is more than academic, since the one disease labeled thyrotoxic exophthalmos is supposed to improve with thyroidectomy, while the other, thyrotropic exophthalmos, is made worse by surgery.

Mulvaney feels that, by careful ocular examination, the clinician should be able to divide his cases of Graves' disease into these two groups. This concept is indeed a tempting one since it would make it possible for the clinician to anticipate a malignant exophthalmos and take proper steps. On the other hand, patients with thyrotoxic exophthalmos could be reassured that the unsightly ocular changes were only temporary.

Mulvaney's thesis cannot be wholly substantiated, however, and I feel that the ophthalmologist cannot be expected to differentiate between the two types which he has proposed. Since no one has proven exactly why exophthalmos and orbital edema occur, one would hesitate to predict the effect of thyroidectomy on the eyes. Furthermore, Mulvaney's criteria for differential diagnosis cannot be applied in the majority of cases of Graves' disease in which ocular signs are present because the intermediate types predominate. Mulvaney's so-called thyrotoxic and thyrotropic signs are mixed to such a degree that classification is not practical.

In Graves' disease, it would appear that, with the exception of the lid signs due to spasm of Mueller's palpebral muscle and probably some extraocular muscle palsies of obscure etiology, the ocular changes result from a disturbance of the pituitary. Although present knowledge of this disturbance is insufficient, it would appear that the severity of the exophthalmic changes depends on the degree of pituitary effect, or thyrotropic effect, acting on the orbit. At present it is impossible to measure this effect with any facility, except as it is reflected in the ocular changes.

These changes in the large majority of cases are minimal. They may progress or they may halt at any stage. It is only in rare cases, however, that decompression is necessary. It is not known why progress in some cases is relentless.

The exophthalmos may begin at any time during the course of Graves' disease, even some years after all other general signs and symptoms of the condition have disappeared. In one case of this present series, exophthalmos started to develop 13 years after thyroidectomy.

When thyroidectomy causes hypothyroidism, exophthalmos is very likely to appear or progress. It is reasoned that a functioning thyroid acts as an inhibitor of the anterior pituitary, and its removal results in an oversecretion from the anterior pituitary of the substance or substances acting on the orbits.

Furthermore, the thyroid hormone, or thyroxin, in addition to antagonizing the thyrotropic hormone, promotes diuresis. Following thyroidectomy and the subsequent decrease in thyroxin, increased water retention may account for the edematous state of the orbit.

A slight majority of progressive cases are

found in males following thyroidectomy.[3, 17] Poppen,[18] in discussing the surgical treatment of progressive exophthalmos, reports a series of 66 patients. Of these, the 26 males and 40 females were aged from 27 to 67 years. The most severe case in my series was that of a relatively young woman. Neither sex nor a high degree of thyrotoxicosis bars severe exophthalmos, and the clinician should not relax his vigilance because a particular case is that of a young woman with severe hyperthyroidism.

Exophthalmos, as related to Graves' disease, does not completely disappear after surgery, regardless of the classification to which it belongs. In fact, in the majority of patients, if exophthalmos is present before surgery, it is present afterward for sometime or forever. A few cases may show an increase. This opinion is based on several reports of large series of cases of hyperthyroidism.[19, 20]

If thyrotoxic exophthalmos is a distinct entity, as claimed by Mulvaney,[1] an adequate series of cases should demonstrate a beneficial effect of thyroidectomy on preëxisting exophthalmos. Interestingly enough, Dobyns[21] measured the eyes of 233 patients after subtotal thyroidectomy. He noted some increase in prominence of the eyes of *all* of the operated cases.

Furthermore, experimentally no one has induced an exophthalmos in normal animals by administering thyroxin. Clinically, if thyroxin is the cause of thyrotoxic exophthalmos, one should see many cases after thyroid has been used. In my opinion, the exophthalmos which would be classified by Mulvaney as "thyrotoxic exophthalmos" is a pseudo-exophthalmos due to widening of the palpebral fissure. As will be brought out later, it is generally agreed that this apparent exophthalmos is due to a spasm of Mueller's palpebral muscle caused by sympathetonia. The signs disappear after thyroidectomy if the basal metabolism rate returns to normal.

It would seem more logical, therefore, to consider the exophthalmos, as related to Graves' disease, as varying only in degree, rather than kind; that is, if present, the exophthalmos is anterior pituitary in origin. Whether present before or after thyroidectomy, the measurable amount of exophthalmos reflects the degree to which the orbit has been affected by the pathologic functioning of the pituitary.

In order to evaluate the ocular status of a patient, it is essential that the exophthalmometer be utilized and that successive measurements be carried out at the same base reading. Some judgment should be used before exophthalmos is diagnosed. It should be remembered that, by definition, exophthalmos is "an abnormal protrusion of the eyeball."

Since it is suspended in the orbit by its various attachments and does not occupy a wholly static position, the globe, when the palpebral fissure is widened due to spasm of Mueller's palpebral muscle, may move forward a millimeter, more or less, as measured on the exophthalmometer. This can also be demonstrated in the normal individual if an effort is consciously exerted to open the lid aperture maximally. This slightly forward position of the globe accompanied by a widened lid aperture should not be called exophthalmos because it is not abnormal.

The physiognomy of the patient should also be taken into consideration. The anterior-posterior distance between the corneal apex of the eye and the lateral orbital rim has a normal variation of from 12 mm. to 15 to 16 mm.

Exophthalmometer measurements may vary up to a millimeter in the same individual on the same day. It is successive, progressive readings, as well as unequal readings, at the same base line which are significant. Unequal measurements, in which one eye is more prominent by 1.5 mm. or more, are evidence that the eye is exophthalmic. The measurement of exophthalmos is a difficult problem clinically and experimentally, and one must be critical about the results reported.

Lid retraction, which is responsible for the

widened palpebral fissure, is one of the most obvious and one of the earliest recorded signs of Graves' disease. Lid retraction can occur with or without exophthalmos.

One type is caused primarily by the spasm of Mueller's palpebral muscle which occurs only in the presence of thyrotoxicosis; here, exophthalmos may be absent. The other type is caused by exophthalmos.

If exophthalmos co-exists with thyrotoxicosis, which is not uncommon, then both spasm of Mueller's palpebral muscle and the forward displacement of the globe, actually spreading the lids apart, act as a combined cause of lid retraction. However, in the absence of thyrotoxicosis, particularly after operative removal of the thyroid, lid retraction is caused only by proptosis of the globes.

Lid retraction is, therefore, an early reliable sign of exophthalmos when the basal metabolism rate is not elevated, and its presence should cause the examiner to take exophthalmometer readings. Frequently, lid retraction, due to exophthalmos, is at first unilateral since proptosis is often assymetrical. The condition in one eye progresses in advance of that in the other.

If the basal metabolism rate is elevated in the thyrotoxic patient, one must remember that the retracted lid may be due to spasm of Mueller's palpebral muscle alone and exophthalmos may be absent. In these cases the degree of lid retraction is usually equal on both sides, while the exophthalmometer will show normal readings.

Lid retraction, due primarily to spasm of Mueller's palpebral muscle, is important as a diagnostic sign of Graves' disease. Lid retraction due to exophthalmos is more important because the severe grades denote marked protrusion of the globe. If the process advances, the retraction may contribute to the edematous phase by pinching off the venous arcades of the lid.

Limitation of ocular rotation frequently accompanies exophthalmos, since the extraocular muscles are often affected by the general pathologic condition. Palsies may become evident before exophthalmos develops. Elevation is often affected first, followed by abduction. Weakness of the superior recti is characteristic of this condition. When the process is advanced, permanent fibrotic changes in the ocular muscles cannot be altered by decompression.

It should be pointed out that Graves' disease occurs in conjunction with myasthenia gravis in about six percent of the cases.[22] Extraocular palsies due to myasthenia gravis differ, however, from the type which accompanies exophthalmos. One should not hesitate to use prostigmin in a therapeutic trial.

Few studies, except in those cases in which decompression was performed, have been made on the extraocular or skeletal muscles in Graves' disease. It is, therefore, difficult to be certain of the pathologic process. However, some biopsies of the extraocular muscles in Graves' disease, have shown no pathologic findings except those already described. Mulvaney's pathologic findings in thyrotoxic exophthalmos have not been verified.[23, 24]

"Orbital swelling" is a term used to describe the external appearance of the advanced case of thyrotropic exophthalmos. It is a relatively late manifestation and indicates that the increased intraorbital pressure has progressed sufficiently to disturb the circulatory balance of the orbital tissues. Every patient with this sign should be examined frequently; the possibility that decompression may be necessary should always be kept in mind.

Externally, there is a fullness of the lids which varies in extent from a minimal stage to marked gross edema involving all of the subcutaneous tissue of the lids. This edema can be palpated, and edema fluid will escape when a needle is passed through the tissues during tarsorrhaphy. Edema also involves the conjunctiva, the lower conjunctiva being affected first (gravity). The advanced cases may show chemotic conjunctiva herniated be-

tween the tightly swollen lids.

With the proptosing globes stretching and pushing the lids ahead of them, a time comes when the cornea no longer can be covered. In advanced cases, exposure causes the corneal tissues to break down and become ulcerated. In addition, the edematous condition of the orbit and conjunctiva upsets the basic nutrition of the cornea and makes it susceptible to exposure keratitis. When the cornea shows evidence of breakdown, the condition requires emergency therapy.

Another manifestation of thyrotropic exophthalmos is papilledema. This may occur before the disease is far advanced and may make difficult the differential diagnosis from orbital tumor, as one of the cases herein reported illustrates. The cause of the papilledema is not certain but probably it is related to a disturbance of the retrobulbar tissues, with the orbital hyperplasia producing venous stasis.

Headache, a most important symptom, should always warn the ophthalmologist that some definitive therapy may be necessary within hours. As the process advances into the severe phase, the patient often will complain of pain about the orbit. The pain is proportional to the degree of protrusion of the eyes. It may be severe in those cases in which decompression is indicated. The headache, which is worse at night, is often relieved by sleeping with the head elevated by several pillows.

Treatment

The ideal treatment to remove the cause of disease, has not been found. At present, treatment is usually directed either toward the process involving the orbit or that of the pituitary.

It is most difficult to evaluate treatment of the pituitary since, in most cases, the pathologic process is spontaneously arrested. The rationale is to depress pituitary activity, thereby decreasing production of the substance which acts on the orbit to produce exophthalmos.

Among the many therapeutic measures tried is irradiation of the gland by deep voltage X rays. Large dosages of X rays are necessary. It would seem that the questionable results reported do not justify generalized depression of a master gland, such as the pituitary, by destructive X rays. In several cases herein reported, the process progressed regardless of the X-ray therapy.

Another method is to prescribe a hormone antagonistic to the pituitary; for example, thyroid. In my opinion, this is to be recommended since in many patients hypothyroidism follows thyroidectomy. The ocular condition in some cases seems to be benefited by this therapy.

When therapy is directed toward the orbital condition, preservation of the globes is the most important consideration. Although in the majority of cases the process is arrested before the globes are threatened, the ophthalmologist must be able to recognize the signs of fatal progression. Corneal breakdown with infection can result in the loss of an eye in a short time. In this series of cases, five eyes were lost. A haphazard perusal of the literature shows a number of neglected cases, the tragic results being well documented by photographs.

Today, decompression of the orbit can be successfully performed in several ways. With the proper choice of when to operate, there is little excuse for lost eyes. Eyes are lost from infection due to exposure keratitis and from drying of a cornea whose nutrition has been disturbed by the pressure of the edematous tissues about it. When the patient has orbital pain with manifest orbital swelling, decompression should be considered. The edema can progress from a serious to a critical point overnight.

In considering the "how" and "when" of decompression, the general condition of the patient should always be evaluated. A difficult problem is made more difficult when a severe case of exophthalmos develops together with an equally severe case of thyrotoxicosis. Obviously such a case demands

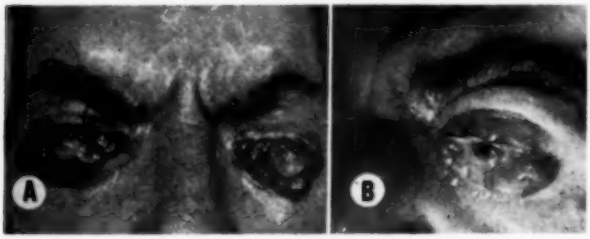

Fig. 1 (Dayton). Case 1. (A) Note the drain inserted into the lower fornix. (B) Note severe orbital swelling.

close coördination between the internist and ophthalmologist. At present it is possible to control the thyrotoxicosis by medical therapy and proceed with decompression. Thyroidectomy may follow later.

Decompression may be performed according to several techniques.

The Naffziger operation, which consists of unroofing the orbit by an intracranial approach, is the best known. It is satisfactory, and no patients in this series complain of pulsation of the globes. The operation permits thorough exploration of the orbit, an advantage when a tumor is suspected.

Another method is decompression from below through the maxillary antrum. I have seen a good result with this approach.

The Krönlein operation, a temporal approach, has its advocates and is undoubtedly a satisfactory procedure.

The important factor no matter which technique is used is to decompress and allow the orbital pressure to spread elsewhere, instead of driving the globes forward. Recent advances in surgical technique make the dangers of decompression few and most of the objections, such as danger of infection, are no longer valid.

Frequently, after decompression, there is an increase in orbital edema for the first 48 hours. It is unfortunate if the ophthalmologist has delayed surgery until corneal breakdown is advanced for irreversible changes may occur during this critical period.

To suture the lids without decompression in advanced cases is valueless because the globe is squeezed between an irresistible force (the intraorbital pressure) and an immovable object (the lids). If decompression is performed at the same time as lid suture, there is some value because the cornea is covered until the eyes recede. Some surgeons[15] advocate a pressure bandage over the globes as a method of reducing the postoperative swelling. In the moderately advanced case which is not progressing a lateral tarsorrhaphy gives an excellent cosmetic result.

Case reports

Case 1

Severe exophthalmos with thyrotoxicosis which resulted in corneal ulceration and loss of both eyes

M. P., a 59-year-old man, was seen because of tremor of the left side with disturbance of speech. The patient had noted prominence of the left eye for one month with diplopia and blurring of vision.

Examination revealed hyperthyroidism, essential hypertension, and postencephalitic Parkinsonism. His basal metabolism rate was +66 percent. He had been admitted two months earlier for Parkinson's disease and questionable hyperthyroidism. No ocular changes had been noted at that time.

On the second hospital day the Ophthalmology Department was called in consultation. Both eyes were proptosed, but in the left the condition was more advanced, with early corneal ulceration. He was treated for conjunctivitis with argyrol and bichloride of mercury ointment. The proptosis increased in both eyes until both corneas ulcerated.

The patient was treated surgically 13 days after admission. The left eye was completely covered by a conjunctival flap followed by a Wheeler type tarsorrhaphy. The flap stayed

in position for one week when the increased prominence of the eye pulled the sutures loose. The eye was lost.

In the meantime, rapidly developing proptosis of the right eye was followed by severe corneal ulceration. A drain was inserted in the lower fornix (after the method of Ruedemann) in a tunnel from the outer to the inner canthus beneath the inferior rectus. This eye progressed to blindness two weeks after surgery. Neurosurgical consultation was obtained after the second operation, but the process was too far advanced.

The treatment in this case should have been early decompression. When it became obvious (as it was on the first ophthalmic consultation) that the cornea was breaking down, decompression should have been resorted to without delay. The danger of a patient becoming blind is sufficient reason to risk major surgery. It is not so important to cover the cornea as it is to release the intra-orbital pressure which is pressing the eye forward. The thyrotoxicosis can be controlled medically with an antithyroid drug, such as Propythiouracil, while full attention is directed to saving the eyes.

CASE 2

Severe exophthalmos with thyrotoxicosis. Bilateral orbital decompression with good results

G. T., a 63-year-old man, was first seen one year ago, with thyrotoxicosis and thyrotoxic heart disease. The initial basal metabolism rate was +72 percent. His eyes had been prominent since Graves' disease had been diagnosed. He was treated with Thiouracil with good results as far as general health was concerned.

Five months before admission to the hospital he was seen in consultation by the ophthalmologist. At this time the eyes protruded 20 mm. on the right side and 21 mm. on the left. He had slight conjunctival chemosis.

During the next four months this chemosis became steadily worse, and the patient developed a severe limitation of elevation of the eyes. The extraocular palsy was severe enough to make the patient tilt his head backward.

The edema and proptosis advanced steadily until it was necessary to decompress the orbits. This was done by the Naffziger method. The night after surgery, severe swelling developed around both orbits. This subsided over a 36-hour period.

Eight months after surgery, the exophthalmometer measured 16 mm. on both sides. After an elective thyroidectomy, the patient made the uneventful recovery.

In this case, which could have ended like Case 1, both eyes were saved by decompression at the proper time. The patient was benefited by the close coöperation of the ophthalmologist, neurosurgeon, and internist. The thyrotoxicosis was controlled medically until the time was opportune to perform a thyroidectomy without danger to the patient.

CASE 3

Severe bilateral exophthalmos following thyroidectomy

Mrs. E. S., aged 38 years, had a thyroidectomy nine months previous to admission. Her basal metabolism rate before surgery was +53 percent. Two weeks postoperative the patient noted puffiness of the face and eyes. She was started on thyroid extract.

Eight weeks after surgery she was aware of increased prominence of both eyes, and shortly after this she complained of diplopia. Her eyes became progressively proptosed. One week before admission she noted inability to elevate the right lid. She had completed a course of X-ray therapy, totaling 2,000 r, to her pituitary with no improvement.

On admission she had a right hypertropia, a right ptosis, marked exophthalmos, and slight conjunctival edema. There was increased tearing. It was decided to try ACTH. She received 80 mg. a day for six days with no improvement. The day after ACTH was discontinued, the orbital swelling became

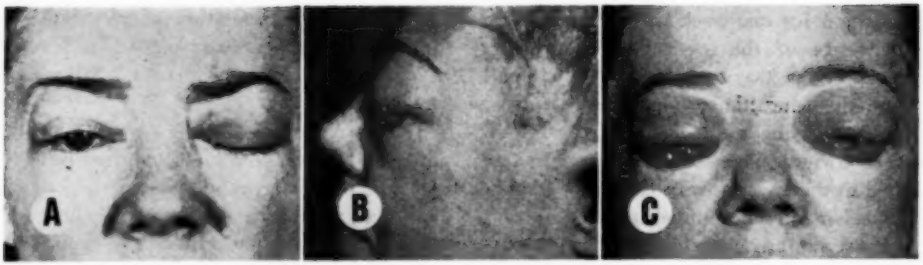

Fig. 2 (Dayton). Case 3. (A) Front view on admission. Note the ptosis which covers the cornea. (B) Side view after decompression surgery but before the lids were sutured. (C) Front view after decompression operation. The ptosis of the right lid has been masked by the extreme proptosis and swelling.

marked within 12 hours. The conjunctiva protruded between the lids, and she complained of severe pains about both orbits.

Both orbits were decompressed that afternoon by the Naffziger method. After surgery, the swelling increased. Ten days later both corneas became ulcerated, and the lids were sutured together.

Shortly after this the blood pressure fell and the patient went into shock. She developed a complete heart block and died in 48 hours. The pathologic findings and their significance were mentioned earlier in this paper.

This case was extremely interesting from several standpoints. The orbital edema became markedly increased overnight, illustrating why these cases should be carefully watched. ACTH, X-ray therapy to the pituitary, and thyroid extract did not retard the condition. The corneas broke down after the decompression operation. This might have been avoided by suturing the lids at the time of surgery.

The complete ptosis of the right lid is evidence of severe involvement of the superior palpebrae levator. This was proven histologically. Rundles and Pochin[25] state that involvement of the levator is responsible for lid retraction. As this case demonstrates, involvement of the levator leads to weakness of this muscle with ptosis, rather than to the increased tone of the muscle necessary for lid retraction.

CASE 4

Severe bilateral exophthalmos following thyroidectomy with loss of one eye due to corneal ulceration

Mrs. H. K., a 59-year-old woman, had a subtotal thyroidectomy for Graves' disease one year previous to admission. Five months following thyroid surgery she noticed prominence of her left eye. Her right eye began to protrude a few months later; the condition became increasingly worse.

Two months before admission she began to experience intermittent attacks of diplopia. One month before admission she was treated by an ophthalmologist for conjunctivitis, and her glasses were changed.

In the hospital, exophthalmometer measurements were: R.E., 26 mm.; L.E., 28 mm. The conjunctiva was injected; the chemosis was moderate. There was marked weakness of upward gaze.

A Naffziger orbital decompression was done on both eyes. On the third postoperative day, a corneal ulcer developed in the left eye in spite of the moist-chamber dressings, which had been applied to both eyes immediately following decompression. The left eye was lost within 10 days.

At surgery biopsies of the orbital fat and extraocular muscles were taken. Microscopically, the specimens showed the usual pathologic picture described by Naffziger and others.

This case points up the problem of

whether to suture the lids at the time of decompression. Perhaps if this had been done, the left eye would not have been lost.

CASE 5

Moderate exophthalmos following thyroidectomy

Mrs. S. M., aged 51 years, underwent a thyroidectomy for Graves' disease when she was 37 years old. Preoperative basal metabolism rate was +53 percent. Histologically, the gland was typical of Graves' disease.

Since surgery she had been followed in the metabolic clinic continuously because of hypothyroidism. She has been taking thyroid by mouth for years. She was seen occasionally in the eye clinic for retraction with no other ocular signs noted.

Fourteen years after her thyroid was removed she noted increased prominence of the right eye. She was referred for ocular examination on July 29, 1950, at which time, the exophthalmometer showed: R.E., 20.5 mm; L.E., 18.0 mm. Six months later the readings were: R.E., 22.0 mm.; L.E., 21.0 mm.—a 1.5-mm. increase on the right and 3.0-mm. increase on the left.

The patient also complained of occasional diplopia, particularly at the theater. She had definite limitation of movement upward. No change had been noted for four months. She had had no pain or orbital swelling. X-ray study of both orbits was normal as was neurologic examination.

This, I believe, is a case of "thyrotropic" exophthalmos which developed 13 years after thyroidectomy. The condition has remained static for four months. Nevertheless, the patient should be carefully followed, since rapid progression is not unusual.

CASE 6

Moderate exophthalmos following thyroidectomy with persistence of hyperthyroidism

Mrs. M. W., a 39-year-old white woman, was first seen December 26, 1950. She had had a thyroidectomy in 1946. She had noted prominence of her eyes for the preceding six months. Exophthalmometer measurements were: R.E., 17.0 mm.; L.E., 15.0 mm. Lid retraction was evident bilaterally.

Her basal metabolism rate was +30 percent. Her extraocular movements were full. The left lobe of her thyroid was palpable.

On January 23, 1951, her basal metabolism rate was +42 percent. She was started on Propylthiouracil because of thyrotoxic signs.

Remeasurement of eyes on February 22, 1951, showed: R.E., 20.0 mm.; L.E., 18.0 mm. Her eyes had become more proptosed. There was swelling of both lids with lid retraction.

On March 17, 1951, exophthalmometer measurements were: R.E., 21.0 mm., L.E., 19.0 mm.—an overall 4.0-mm. increase in each eye in four months. She was continued on Propylthiouracil and felt fine with a basal metabolism rate of +20 percent. However, on May 11, 1951, exophthalmometer readings were: R.E., 23.0 mm.; L.E., 21.0 mm.—an increase of 2.0 mm. in each eye in one month's time. She had orbital pain and marked lid retraction.

She was admitted on the ophthalmologic service for study. Propylthiouracil was stopped, but her basal metabolism rate promptly increased. She was then placed on iodine. Her basal metabolism rate dropped for two weeks but, on last measurement, had returned to +50 percent.

This case illustrates how complicated the

Fig. 3 (Dayton). Case 6. (A) Side view. (B) Front view. Note the marked lid retraction. The patient has an elevated basal metabolism rate.

combination of thyrotoxicosis with exophthalmos can become. The patient has had a partial thyroidectomy, the left lobe being intact. She still has thyrotoxicosis, however.

The exophthalmos evidently was initiated by removal of part of her thyroid. The lid retraction is a result of exophthalmos and thyrotoxicosis. The question now is how to control the thyrotoxicosis without causing an increase in the exophthalmos. It would seem Propylthiouracil is equivalent to thyroidectomy since, in this case, its depression of the thyroid caused a proportional increase in the proptosis.

It is not possible to predict the ocular outcome in this case. However, it may be that the eye condition will progress to such a degree that decompression will be necessary.

CASE 7

Exophthalmos with papilledema

H. C., a 56-year-old man, underwent a thyroidectomy three years previously. His basal metabolism rate before surgery was +53 percent. At that time his eyes were normal in appearance. He is a diabetic.

Nine months before examination he complained of increased tearing of both eyes. Recently he has noticed blurring of vision and injection of the left conjunctiva. His lashes touched the left lens of his glasses.

On admission, exophthalmometer measurements were: R.E., 20 mm.; L.E., 23 mm. The vertical diameter of the palpebral fissure was 8.0 mm. on the right and 10 mm. on the left. He had diplopia on looking to the left. His left fundus showed two diopters of papilledema.

Neurologic examination was normal except for the findings noted. The impression was a slow-growing orbital tumor on the left. A left frontal craniotomy was done.

Orbital exploration revealed only a generalized edema of the retrobulbar tissue. After orbital decompression the exophthalmos receded, and the papilledema disappeared.

This case illustrates the difficulties of differential diagnosis. Undoubtedly from the history and findings at surgery, this is a case of thyrotropic exophthalmos. Of course, this is hindsight.

CASE 8

Moderate exophthalmos following thyroidectomy

R. M., a 33-year-old woman, was admitted for treatment of exophthalmos with ACTH. She noted two years ago nervousness, instability, sweating, and loss of weight. At this time she was treated for thyrotoxicosis by means of radioactive iodine. Her symptoms did not improve, and her eyes became prominent. One year ago she had a thyroidectomy.

Her basal metabolism rate before surgery was +41 percent. Her symptoms of thyrotoxicosis disappeared following surgery, but her eyes increased in prominence.

Four months before admission, the exophthalmometer reading on the right eye was 24.0 mm. and on the left eye, 23.0 mm. The same reading was found on admission.

In the hospital she was given a course of ACTH. No change in the eyes was noticed. At present she has increased tearing, but

Fig. 4 (Dayton). Case 8. A patient showing this type of case is greatly helped cosmetically by a lateral tarsorrhaphy.

Fig. 5 (Dayton). Case 9. (A) Front view. Note the elevated chin with the backward head tilt which is an attempt to compensate for the weakness of elevation. (B) Side view to illustrate the awkward posture.

both corneas can be covered. No diplopia is present. This patient's condition may remain static, but observation is essential.

This type of case is common in a metabolic clinic. If the exophthalmos remains static, a plastic operation should be done on the lids. These patients are aware of and sensitive of their "bug-eyed" appearance. It was because of this that the patient wanted to try ACTH.

CASE 9

Moderate exophthalmos following thyroidectomy

L. K., a 63-year-old woman, had a thyroidectomy two years ago. She stated that her eyes were prominent before surgery but got much worse immediately following operation. One year ago her eyes were tearing, the conjunctivas were chemotic, and the patient complained of pain about both orbits. At this time she had two courses of X-ray therapy to the pituitary.

At time of examination, the patient had a marked tilt of her head backward which gave her a peculiar appearance. This was caused by marked weakness of elevation of both eyes. She stated that she has occasional diplopia. Conjunctival chemosis was less than one year ago.

Exophthalmometer readings were: R.E., 27.0 mm.; L.E., 27.5 mm. Her condition has remained static for six months. She is taking thyroid by mouth.

This woman has developed a paralytic strabismus, for which surgery on the extraocular muscle is desirable.

SUMMARY

The relation between exophthalmos and the thyroid gland is poorly understood but the condition probably is anterior pituitary in origin. The solution of the problem will require further experimental and clinical work.

Experimentally, much work remains to be done to find the exophthalmic factor or factors of the anterior pituitary. Clinically, these cases should be studied from all aspects to determine just what pathologic physiology is producing the exophthalmos.

Until the etiology is known, the ophthalmologist should keep an open mind. It is safest to assume that every patient with Graves' disease may develop malignant exophthalmos. Although an uncommon cause of blindness, this condition is a real threat to vision when it is progressive. The ophthalmologist should not confuse an apparent exophthalmos with a real exophthalmos.

Exophthalmos alone is not an alarming sign. It is alarming when accompanied by orbital swelling and extraocular muscle palsies. Cases have been known to progress markedly within hours. This means that frequent observation of the more severe type is essential. When it is necessary, the ophthalmologist should not hesitate to recommend decompression surgery.

Nine case histories are presented. In this series, five eyes were lost and one patient died.

Autopsy in Case 3 showed widespread involvement of most of the skeletal musculature by a subacute myositis including the

extraocular muscles and the heart. This case showed how generalized this process may become.

The nine cases illustrate the vagaries of this disease. The ocular signs appeared any time from months to 13 years after the initial thyroid disturbance. Both sexes were represented and the patients ranged in age from 33 to 63 years. In two of the most severe cases, the thyroid was intact, while in the remaining seven, thyroidectomy had been done. The outstanding ocular change was an actual, measurable exophthalmos.

A symptom of importance, which was present in the severe forms, was dull pain about the orbit. The exact explanation for this symptom is unknown though it might well be caused by orbital swelling, with subsequent stretching of the tissues about the eyes. When this symptom is present, the ophthalmologist should be ready to consider some type of decompression surgery.

Medical treatment with thyroid by mouth and X-ray therapy to the pituitary have not proved effective in arresting the ocular process. However, the medical treatment of thyrotoxicosis with Propylthiouracil appears to act much the same as a thyroidectomy insofar as the eyes are concerned. This is well illustrated in Case 6 in which, though the basal metabolism rate fell with Propylthiouracil, the prominence of the eyes increased markedly.

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OBSERVATIONS ON BLOOD SLUDGING*

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Some years ago, nutritionists were evaluating ophthalmologic findings, as seen with the slitlamp, in relation to nutritional deficiencies. Many errors of interpretation crept in, until ophthalmologists pointed out that some of the so-called ocular findings of deficiency were really expressions of local conjunctival irritation. A proper evaluation soon followed.

This paper is now presented to stimulate the interest of the oculist in the slitlamp interpretation of blood sludging, since many cases regarded as demonstrating early evidences of blood sludging and pathologic conditions are really showing variations of normal circulation.

Adler[1] rightly notes "the variation in the appearance of the capillaries and arterioles in the (normal) conjunctiva of man may vary from vessel to vessel so that caution must be observed in connecting changes found with a particular disease or even for that matter interpreting them as indicating a disease state."

Gartner,[2] in doing photographic studies on the conjunctival vessels, also noted the variations in different vessels of the conjunctiva in the same patient at the same time. In some vessels he says there is a swift current flowing evenly. In others the blood flow is slow and irregular, or the blood flow may stop and reverse. A pulsating movement synchronous with the heart beat may even be observed in some vessels.

Donders,[3] Jaeger, Ruedemann,[4] and Bedell have given excellent descriptions of the anatomy and physiology of the conjunctival vessels.

Ploman[5] in a study of the agglutination of red cells of the retinal vessels induced by varied pressure on the globe felt there was a constancy in the elapsed time from when pressure was applied to the development of agglutination. He was able to differentiate time in one fifth of a second by use of a switch built into the ophthalmoscope and connected with a kymograph. He concluded that, if pressure produced an agglutination in three seconds or less, then a pathologic condition or pregnancy was present.

To date, however, no ophthalmic article has appeared on the subject of blood sludging of the conjunctival vessels, yet the number of papers on this subject by men in other fields are increasing day by day. These articles are well grouped in a paper entitled "Annotated bibliography of sludged blood,"[6] and show that intravascular agglutination has become identified as the cause of specific pathologic findings and plays a role in many conditions varying from shock, burns, and toxemia of pregnancy to mental disease.

In 1852, Coccius[7] published microscopic observations of agglutinated blood in living

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human patients. Robin Fahraeus[8] devised the sedimentation rate test and showed that the increased sedimentation rate of the red cells of blood drawn from human patients was due to alterations in the chemistry of the plasma rather than to detectable changes in the blood cells themselves.

Knisely and his co-workers have in a series of papers demonstrated the practicality of studying sludged blood in the bulbar conjunctival vessels. They feel that the flowing blood passing through any tissue is a valid sample of all the flowing blood in the body excluding, of course, those cases in which local sludging is due to local trauma. Their method of examination gives about ×64-diameters magnification although magnifications of ×32, ×48, and ×96 have been used.

Heimbecker[9] does not concur and found that the degree of sludging in the conjunctiva and nictitating membrane of experimental animals was more marked than that observed simultaneously in the omentum and mesentery and believes that vasoconstriction affects cutaneous vessels earlier than visceral vessels.

The term *sludge*, coined for intravascular agglutination by Knisely (because of its brevity), describes a suspension of solid or semisolid particles in a fluid, in this instance, red cells in plasma. The capillaries through which blood is flowing normally vary from a little less than one to as much as two to two and one-half times the diameter of the passing red cells. This is true of the arterioles and capillaries of the bulbar conjunctiva of human beings where red cells usually are a little less than 8.0μ in diameter.

Hirschboeck and Woo[10] concluded that blood sedimentation phenomenon was merely an in vitro manifestation of the process of sludging in vivo. The in vitro sedimentation is determined by a rise in fibrinogen in the plasma facilitating the erythrocyte aggregation. Dr. Seymour Gray[11] injected electrophoretically purified beef fibrinogen into guinea pigs and caused a profound sludge. The addition of fibrinogen to normal citrated blood causes increased sedimentation. The factors which cause intravascular agglutination of erythrocytes, however, have not been definitely determined. Some theories are:

1. Knisely feels that a precipitate forms which coats the red cells, sticking them together in masses. He finds that sludging is reversible unless it is at the end-stage. In experimental animals (monkeys) with malaria, quinine and atabrine seem to be able to reverse the process.

2. Bloch,[12] with the use of an electron microscope and magnifications from 3,500 to 20,000 diameters, showed red blood cells normally have a sharp outline; whereas, those from sludged blood were irregular in outline and covered with a coating.

3. Enzyme action. Meyers and his co-workers suggest that probably all highly asymmetrical molecules of large size will increase sedimentation. This could include the molecules of bacterial enzymes. Injured tissue releases thromboplastin. The latter plus the prothrombin complex leads to the formation of fibrin. Inactivated thrombin can now be ascertained, as described by Sternberger.

4. Electrokinetic theory. Electrokinetic properties of red cells of sludged blood differ from those of red cells of normal blood.

5. Roizin and his co-workers[13] in a preliminary report have found sludge in cases of multiple sclerosis. Nathanson[14] and his co-workers have reported an increased platelet adhesive index in multiple sclerosis. One might reason the possible correlation of sludge and increased platelet adhesive index. Actually, however, it does not work, as the latter test is too variable, being positive on one examination and negative on another.

6. Hirschboeck and Woo believe the occurrence of sludge is related more closely to the rate of blood flow than to any other specific process. Knisely, however, feels the rate of flow only allows for better observation but does not explain the occurrence of the sludge.

The difficulty in interpretation of the sig-

nificance of blood sludging can be seen in the opposite viewpoints of Knisely and Laufman. Knisely and his co-workers examined 50 normal individuals and found no blood sludging. Laufman and his co-workers[15] found sludge varying from nothing to plus four in the same individual over a period of a week. They also found it varied during parts of the day and observed that, before and during menstruation, sludge occurred even though it was not present before. I have also found this to be true. No evidence of infection, either low grade or severe, or any other demonstrable pathologic process was detected.

Robertson, Wolf, and Wolff[16] examined five normal subjects daily for 10 minutes and noted day-to-day changes in sludge.

It would seem to me that agglutination into clumps with spaces of clear plasma between them constitutes a typical example of sludge and not temporary columnar adherence of red cells to one another in a small vessel in which the circulation is slow. When one examines a case with a high sedimentation rate, say in the eighties, all vessels, including the aqueous veins, show the sludge, not just one part of one vessel.

One should be stricter in his definition of sludge and eliminate those findings localized to one vessel in an area where the blood column is slowed, either by direction or localized constriction.

During the past year, 150 cases that showed sludging were studied for correlation of the sludging and other factors. In 80 percent of these cases, sedimentation rates were done and 50 percent showed an increase in the sedimentation rate. All cases with sedimentation rates above 30 mm. showed marked sludge. In 50 percent, there was local sludging with no increased sedimentation rate. This finding is consistently present in cases of anxiety.

It would seem to be a good routine to do sedimentation rates in all cases which show marked sludging. Since infection and malignancies, as well as pregnancy after the 12th week and anemia, show increased sedimentation rates, a better understanding of the patient may be gained thereby. One should remember, however, as pointed out by Knisely in an, as yet, unpublished paper, that there are false-positives as well as false-negatives in the sedimentation rate.

A basic disorder of personality is frequently present in patients with retinitis centralis serosa. Since an attack is many times brought on by emotional stimuli, this disease is one of those grouped as psychosomatic disorders. In a specific type of personality which has been subjected to stress over a period of time, the upset in autonomic control is related to stimulation to the psyche. Anxiety is frequently present in such cases and blood sludging is a universal finding in persons suffering from anxiety. Retinitis centralis serosa is also called central angiospastic retinopathy, a term which draws attention to the part vascular disturbance plays in the mechanism of its production.

Following Fowler's theory[17] of the etiology of Ménière's disease which proposes that this condition is related to periodic plugging of the small blood vessels within the labyrinth by sludge, the vascular flow in the conjunctival vessels was studied in eight cases of retinitis centralis serosa. All eight cases showed blood sludging.

Generally, the sludging was not associated with an increased sedimentation rate, indicating, therefore, that there was no relationship to infection. These eight cases followed the pattern found in 14 cases of anxiety all of which showed sludge of the conjunctival vessels and sedimentation rates which were three times as frequently normal as elevated.

Cannon[18] and others have shown many of the small blood-vessel changes that occur with anger and fear and attribute them to sympathin and epinephrine secretion. In susceptible individuals, local instillation of epinephrine into the conjunctival sac or placing a piece of ice on the back of the neck produced vasospastic episodes in the conjunctival vessels conducive to easier visuali-

zation of the clumping of the red cells.

I have seen the same phenomenon in a patient with retinitis centralis serosa who, after refraining from smoking for one year on doctor's orders, was given a cigarette to smoke, being observed before and after with the slitlamp. Definite angiospasm occurred, and it was also possible better to visualize the sludging present. The part attributable to the nicotine and the part due to the emotional tension of the experiment could not, however, be differentiated.

A recent study by Burn[19] shows that smoking inhibits a diuresis caused by drinking water. The inhibition is due to the release of an antidiuretic hormone from the posterior lobe of the pituitary and this is found in the urine after smoking. The hormone is believed to be similar to vasopressin which has the ability to contract blood vessels including the coronary vessels of the heart.

In one other case of retinitis centralis serosa, seen by Dr. John H. Dunnington in consultation, the patient showed 5/200 vision with a central scotoma. Conjunctival sludge was plus three. His vision was entirely eccentric and persisted in this fashion for 10 months with no improvement with the usual therapeutic approach of vasodilators and phenobarbital. Very shortly after he was rejected for service in the Army because of his eyes, he noted an improvement in vision and, when seen six weeks later, the edema had completely disappeared, vision was 20/20 and conjunctival sludge was no longer present.

A related observation is that of David Macht, reported in the *Journal of the American Medical Association* (1952). He found that, among the donors to the Red Cross blood program, the blood of individuals who gave blood the first time (and supposedly were more apprehensive than if they were accustomed to the experience) clotted faster than the blood drawn from repeated donors.

A little less than five percent of postoperative abdominal cases develop thrombosis, and 50 to 60 percent of patients in bed for two or more weeks show thrombi in the muscles of the calves of their legs, if these are sectioned.[20]

One asks then, are there common factors between blood-sludging phenomena and thrombosis and clotting problems? Lessened blood volume, changes in viscosity, vasoconstriction, and slower rate of flow contribute to sludging, and sludging predisposes to a true thrombus with associated stagnation and anoxia; however, endothelial injury is important in thrombosis.

Heparin does not prevent sludge formation. Anticoagulants prevent thrombus formation in the presence of sludge by preventing the sludged masses of cells from adhering to the endothelial lining of the vessel.

Virchow concluded three factors to be of importance in thrombus formation: (1) Changes in the constitution of the blood; (2) changes in the blood vessel; (3) disturbances in circulation. Knisely believes the basic masses, when present, may be the nuclei around which thrombi are built.

An attempt was made to influence sludging by local instillations into the conjunctival sac. Dionine was of no value. Cortisone, which produces vasoconstriction, did not help. When hyaluronic acid is added to saturated blood both the sedimentation rate and rouleaux formation are increased. The addition of hyaluronidase has a reverse effect. For this reason local instillations of 75 units per cc. of Hydase were used, but were of no value. Systemically, salicylates and tocopherols up to 250 mg. daily were of no value.

Fowler reported improvement in the disappearance of sludging by intravenous procaine, while it is being given. In several cases that I studied one hour and 24 hours after procaine, this therapy showed no effect on sludging.

Plasma, saline, and intravenous electrophoretically purified albumin have been reported as giving temporary improvement in sludging. Trypsin, intravenously, has a fibrinogenolytic effect. I have seen a lessening of sludging in two patients who received

this therapy. It lasted 48 hours after the injection. The number of cases is naturally too small to permit conclusions but the observation is of interest in that trypsin is recommended for use in early thrombosis.

In conclusion, ophthalmologists who are using the slitlamp daily and are in a position to study blood sludge should take an interest in this important problem and help to clear away some of the intellectual sludge now present in the subject of blood sludging.

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THE RESULTS OF SURGERY FOR LOW-TENSION GLAUCOMA*

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In 1857, von Graefe[1] reported that certain eyes showed pallor and cupping of the disc although the intraocular pressure seemed normal. However, the existence of such a syndrome was disputed until the development of the Schiøtz tonometer in 1905 permitted more accurate measurement of ocular tensions. Since then numerous reports in the literature have confirmed the occurrence of excavation of the disc and glaucomalike functional defects in eyes with normal tensions. To such eyes the terms low-tension glaucoma, soft glaucoma, pseudoglaucoma, and glaucoma without hypertension have been applied.

As interest in such cases has grown, many studies have been published in which possible causes for this condition have been suggested. Among the etiologic factors that have been considered are primary cavernous optic atrophy, optic neuritis, lues, calcification and sclerosis of the internal carotid artery, tumors of the optic chiasm, and congenital anomalies of the nervehead. Reviews of this subject have been presented in recent years by Dalsgaard-Nielsen,[2] Sjøgren,[3] and Blazar and Scheie.[4]

Before a diagnosis of low-tension glau-

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coma can be established, a search must be made for all possible primary causes for excavation of the disc.

In addition, a careful study is necessary to uncover the possible presence of true glaucoma with masked or intermittent ocular hypertension. For this purpose repeated tonometric measurements must be made, diurnal tension variations studied, and allowances for ocular rigidity calculated. The various provocative tests and tonography should also be employed to unmask a latent glaucoma.

The need for such intensive investigation was emphasized by vom Hofe,[5] whose analysis of a large number of eyes reported to have had low-tension glaucoma demonstrated a high incidence of diagnostic error in such cases.

When a primary cause for excavation of the disc is found, or when latent ocular hypertension is uncovered, the therapeutic indications are generally clear. However, in true low-tension glaucoma in which the basic etiology is still uncertain, the proper treatment is a matter of dispute.

Those who subscribe to the theory that the fundamental pathologic process is a variant of primary optic atrophy, possibly on a vascular basis, generally feel that all treatment is futile.

The other popular concept of the cause of low-tension glaucoma is that, in eyes so affected, even tensions within the usual normal range are excessive, possibly due to a poorly developed lamina cribrosa. In such eyes, therefore, hypotension may actually be necessary to prevent cupping and atrophy of the optic nerve. Advocates of this theory accordingly recommend the use of miotics to lower the tension and, if these fail to control the progress of the disease, filtering operations or cyclodialysis are advised.

Since the diminution in visual acuity and the limitation of field that occur in low-tension glaucoma are usually progressive, and medical treatment with miotics is often unsuccessful, the advisability of surgery in such cases is a recurring question. Inquiry has disclosed a remarkable difference of opinion among ophthalmologists as to whether surgery may benefit such eyes or had better be withheld even in the face of the progressive visual loss which these eyes may sustain. The present study was undertaken to evaluate the results of operation performed on a series of such eyes.

Method of study

The records examined were those of patients operated upon at The Mount Sinai Hospital between the years 1933 and 1948, inclusive. The study was limited to those patients who preoperatively had been under the observation of the ophthalmologic outpatient department or under the private care of members of the attending staff. Some degree of uniformity and reliability in preoperative and postoperative examinations was thus sought.

Only those eyes which had never shown a tension of over 28 mm. Hg (Schiøtz) were considered. In addition, no eye was included in this series if the other eye in that patient had at any time shown a tension over this level. This was done on the assumption that if one eye in a patient had ocular hypertension, the other might also have true glaucoma even though this might not readily be detected.

After eliminating all eyes to which these criteria did not apply or for which insufficient data were available, a group of eight eyes in seven patients remained. To each of these the diagnosis of low-tension glaucoma seemed correctly applied, and all of them had undergone surgery for that condition. The ages of these patients at the time of operation ranged from 43 to 79 years. All but two of these patients were women. In five of these patients low-tension glaucoma was present in both eyes although only in one instance had both eyes been operated upon. In two patients the fellow eye appeared to be normal.

In each case, the patient had been under ophthalmologic observation from two to six years before operation, and in each instance miotics had been unsuccessfully employed

for at least two years in an effort to prevent visual deterioration.

The record of all these patients showed that preoperatively, as well as postoperatively, each had been regularly examined periodically by means of tonometry, ophthalmoscopy, and field studies. X-ray examinations of the skull were reported to be negative in the four patients who were so studied.

In each of the eight eyes in this series, pallor and abnormal cupping of the disc were noted and every one of these eyes showed field defects suggestive of those usually seen in glaucoma. In each instance the field changes and visual acuity grew worse under observation although the ocular tension remained within normal range. This progressive loss of visual function was the indication for operation in each of these eyes.

At the time of operation the corrected visual acuity of two of these eyes was 20/70, and the others had vision improvable respectively to 20/50, 20/40, 20/40, 20/40, 20/30, and 20/20 minus. In no eye was the field at the time of operation closer to fixation than 20 degrees at its widest meridian and in only two eyes did it approach within five degrees in any meridian. On a functional basis, therefore, these eyes would generally not be considered as belonging in that category of late glaucoma in which surgery is so frequently unsuccessful.[6]

The operations performed on these eyes were, respectively, Elliot trephination on three eyes, iridencleisis on two eyes, cyclodialysis on two eyes, and a modified Lagrange operation on one eye. None of these eyes was subjected to more than one operation. In five cases the operation was performed by one of the attending ophthalmologists of this service. In the other three instances, the resident surgeon performed the operation assisted by an attending ophthalmologist.

Results

Following surgery, the tension in each of these eyes remained within normal range and in no instance was it less than 15 mm. Hg (Schiøtz). In five cases, no appreciable hypotensive effect resulted from the operation and, in the remaining three eyes of the series, in which some reduction in tension occurred, this averaged less than 5.0 mm. Hg (Schiøtz) in each case.

The immediate postoperative course was complicated in three of these eight eyes. In one eye, hyphema developed; in another, the anterior chamber did not reform for five days; and in a third, a prolonged iritis occurred. In one other patient, an almost mature cataract developed within two years after operation, in an eye in which only slight cortical opacities of the lens had been noticed before surgery.

The visual acuity in each of these eight eyes continued to diminish postoperatively. In one eye the corrected vision declined from 20/70 to 20/200 in one month after operation. In the others acuity with correction was reduced respectively from 20/70 to 6/200 in eight months, 20/50 to 20/200 in two years, 20/40 to 20/70 in one year, 20/40 to 20/70 in two years, 20/40 to 20/200 in two years, 20/30 to 20/50 in one year, and 20/20 minus to 20/40 in three years.

In each one of these eyes, the field defect increased postoperatively within similar lengths of time. In seven of these eight eyes the deterioration of the field was sufficiently marked during the follow-up period so that central fixation was encroached upon in at least one meridian.

Discussion

It is unfortunate that the series of eyes here studied is so small that conclusions drawn from these results must be considered tentative. This is largely due to the fact that the condition of low-tension glaucoma is uncommon and surgery is apparently resorted to infrequently in this disease.

It should be noted, however, that the size of this series is not a true index of the incidence of this condition, or of the number of such patients operated upon, since several cases that may well have belonged in this group could not be included because of in-

sufficient data presented by their records.

To some degree, however, the paucity of cases in this report is compensated for by the consistency of the results found. Although some reduction in the average tension occurred after operation in three of these eyes, in the other five no such effect was noted, and in no instance was actual hypotony produced. Therefore, if the purpose of these operations on eyes with low-tension glaucoma is to produce hypotony, in this series surgery was uniformly unsuccessful.

More important is the fact that the progressive loss of vision and field for which operation was done in each case, seemed to continue after surgery. While it cannot be stated with certainty that this visual decline was not favorably influenced to some degree by the surgery, nevertheless the rate of deterioration in these eyes after operation indicates that the prognosis is not significantly improved by such procedures. Of course, in some of the eyes the visual loss might be attributed to lenticular opacities, but the association of this loss with progressive field deterioration indicates that other factors played a large role. It is noteworthy that in no eye of this series was the loss of visual function halted by surgery.

The postoperative course of these seven patients also suggests that the incidence of complications may be relatively high after surgery for low-tension glaucoma. It would therefore appear from this study that such operations involve an appreciable risk in addition to providing no significant beneficial effect on the progress of the disease.

Conclusions

Eight eyes in seven patients with low-tension glaucoma were operated upon because of progressive loss of visual acuity and fields.

The results following operation indicate that surgery is not significantly helpful in preventing further deterioration of visual function in that condition.

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Ophthalmic Miniature

> The state of the eye, during this period (postoperative) with regard to the presence or absence of inflammation, is known by the appearance of the upper lid, without direct reference to the eye itself. . . . When some derangement has taken place, and an undue degree of inflammation has been established, the eyelid swells, and the swelling may be safely considered to be in proportion to the inflammation, and the treatment may be advantageously conducted accordingly.
>
> G. T. Guthrie,
> *On the certainty and safety with which the operation for the extraction of a cataract, etc.*
> London, 1834, p. 39.

DAVIEL: MODERN SURGEON*

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On April 13, 1752, Jacques Daviel presented before the French Royal Academy of Surgeons a paper entitled, "A new method of curing cataract by removing the lens." As was the custom of the day, the paper was read twice, first in April and again on November 16th. It was published the following year, 1753, in the *Proceedings* of the academy.

I think it is interesting to recall the rather warm discussion before this society one year ago on the topic, "Keratome-scissors section vs. Graefe knife incision." Those present at the meeting will remember that strong feelings were voiced on the virtues of one method and equally strong feelings on the other procedure. Can anyone forget the Kodachromes on the subject shown during the discussion? Fortunately, both methods work very well, so one may take his choice.

Of special interest to us at the moment, however, is the fact that the keratome-scissors section that many of us like so well is basically Daviel's procedure. Fifty years ago this summer in an address before the eye section of the A.M.A., Alvin Hubbell, in eulogizing Daviel, pointed out how far away from the original method the eye surgeons had come. In contrast, during the past 15 years or so, the original method of Daviel in modified form has become very popular. And so this fascinating subject which intrigues us all so much is ending 200 years of lively history.

The first operation in which Daviel deliberately set out to remove a cataract from its normal position behind the iris was performed on April 8, 1747. An account of this was published the following year in *Mercure de France*. The 1752 paper, however, is the one in which he describes his operation in detail and in which he goes to considerable length in defending himself as the inventor.

Jacques Daviel was well prepared through long years of study to originate this important operation. During the last 30 years of his life he devoted his time exclusively to ophthalmology and, to a large extent, ophthalmic surgery. Contrast this with the fact that in our own Academy of Ophthalmology and Otolaryngology, over half of the members still practice eye, ear, nose, and throat specialties.

Daviel was born in La Barre, Normandy, a small village about 60 miles from Rouen. This was in August, 1693, the exact day being uncertain. His parents lived in modest circumstances. At an early age he was sent to Rouen to serve as an apprentice to his uncle, a surgeon. History does not tell us anything about the uncle.

When Daviel was 20 years old, he became a student-surgeon in the French army in the year 1713, serving in a number of hospitals for seven years. In 1720 the plague broke out in southern France. Daviel was one of the first to volunteer to work in the plague area and was commissioned to go to the relief of the plague-stricken sufferers in October. Two years later, while still in the service, he met and married the daughter of a prominent surgeon. They settled in Marseilles, making this place their home for nearly 25 years.

Many of his colleagues died during the dangerous work in the plague area. Daviel received recognition for his work from the king, a fact which was of considerable help to him in being admitted to a mastership in surgery in Marseilles.

A year later he was appointed to the Hotel-Dieu, and a little later he was made the first demonstrator in anatomy and surgery in Marseilles. This privilege lent him

* Presented at the 88th annual meeting of the American Ophthalmological Society, Hot Springs, Virginia, June, 1952.

prestige in the city, and helped him to develop his practice.

It also gave him the opportunity to work with anatomic material for dissection and study. He made good use of his time and material, dissecting almost daily, and thus became most proficient in surgical maneuvers and the use of surgical instruments. Ten years later his work was again recognized by the king, who made him Royal Demonstrator of Anatomy and Surgery.

At this time he had his first occasion to operate for a cataract. He performed a couching operation, and fortunately the result was excellent. This brought him added fame and made him sought after as an oculist. The rest of his life he devoted himself to ophthalmology. In six years his fame as an eye surgeon was so widespread that he was called to Lisbon, Portugal. By 1740 he was made a corresponding member of the Royal Academy of Surgery in Paris. Many other appointments of recognition were made during these years.

In 1746, at the age of 53 years, he moved to Paris. He was appointed surgeon-oculist to the king because of the excellence of his work and also because of his acquaintance with professional friends at court.

In a letter to a friend dated September 30, 1748, it became evident that he was far from satisfied with the cataract surgery of that day. Daviel was well aware of the true nature of cataract, although it was only a relatively short time before his day that cataract was proved to be an opaque lens. Maitre-Jan and Brisseau had independently shown this in 1707, and soon after this Saint-Yves and Petit each had extracted lenses which had become dislocated into the anterior chamber.

In the letter cited, Daviel described two cases of his own which deeply impressed him. The first case was that of Brother Felix, on whom Daviel depressed a cataract in 1745 while still living in Marseilles. He used the sharp-needle technique and encountered much trouble during the operation. At another time he wrote further about this same case. He stated that he enlarged the first opening of the cornea with small, curved scissors, and by this means all that was in the anterior chamber was evacuated. This eye became infected, however, and was lost.

As a result of this operation on Brother Felix, Daviel developed a blunt-pointed instrument with which he continued to depress cataracts. Writing further in this letter, he stated that his method was brought to a "certainty by continuing to work daily on the eyes of cadavers."

The second case mentioned in this letter was that of M. Garion, a wigmaker of Paris. After failing to depress the cataract, Daviel opened the anterior chamber through the lower cornea. The needle was then thrust into the lens which was removed from the eye, followed by a loss of vitreous. Healing was uneventful and the result was so successful that it gave Daviel "great ideas in regards to the extracting of cataracts."

He soon had the opportunity to make use of his "great ideas." This time he deliberately set out to open the eye and remove the cloudy lens from its normal position behind the iris. The patient was a woman, but nothing more is said about her except concerning the operation. In 15 days the patient was well. This first case was followed by others, each one giving greater assurance.

By 1750, Daviel was satisfied that extraction was far superior to the older method of depression of the lens. From then on he performed nothing but extraction of the lens for cataract operations. His success continued, and he finally felt that he could defend his position. In his famous paper, Daviel said that he had then operated 206 times and reported success in 182 cases. Four years later in a letter he stated, "I think no one will doubt the excellence of so good a method, for out of 354 persons that I have operated on 305 were perfectly successful."

During the last six months of 1756 he was able to add 80 more cases to his series, with only one failure among them.

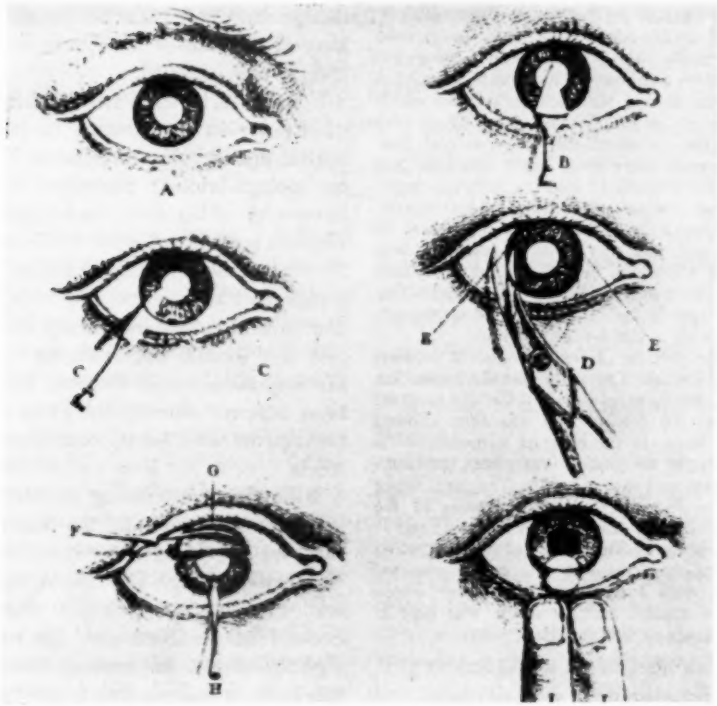

Fig. 1 (Hildreth). Daviel's operation of extraction. (From Daviel's original paper, *Mémoires de l'Académie Royal de la Chirurgie,* Tome 2, Paris, 1752.)

This is an amazing story of success and one that any of us might be proud to be able to report. No one would attempt intraocular surgery today under such conditions. Asepsis in that time was unknown. Local anesthesia was also unknown, yet Daviel said that on poor Brother Felix he had "labored vainly for a half an hour" before enlarging the wound and subsequently removing the lens material. One can only say that the men of those days were made of stern material.

Daviel does not give any analysis of his failures. Undoubtedly suppuration must have been prominent on the list. He does say that the pupil was deformed in some cases (he did not perform iridectomy), and in some cases he would remove iris tissue if there was prolapse. Loss of vitreous was mentioned, but was not considered to be serious.

Cataract spectacle lenses were used at that time, so the successes were as dramatic as those of today. It is easy to see why his well-earned fame spread so far, yet he had great opposition from many surgeons of his period. Many of them did take up his procedure and improve upon it, but nearly a hundred years elapsed before extraction was widely used and the couching operation discontinued.

As to a description of Daviel's operation itself, the following from Hubbell is excellent. It is an accurate translation in brief from the original paper of Daviel:

> The operation which he [Daviel] had invented and now made public consisted in incising the lower part of the cornea exactly at its junction with the sclera. He first made an opening into the anterior chamber at the extreme lower margin of the cornea with a myrtiform or triangular shaped knife, and then, after withdrawing this, he

enlarged the incision on both sides with a narrow, blunt pointed, double-edged knife, as far as he could easily and finally when the cornea became too much relaxed to continue the incision he completed it to the extent desired with delicate scissors which were so curved on the flat and edge as to correspond to the curve of the corneo-scleral line. These, of course, were made right and left, and the blade to be introduced into the anterior chamber was blunt pointed. According to his memoir the incision was of equal extent on both sides of the cornea, and was carried to a point on each side "a little above the pupil." Having completed the incision he gently lifted up the corneal flap with a small spatula and incised the anterior capsule of the lens with a sharp-edged needle.

After doing this, he carried the spatula between the lens and the iris, "so as to entirely loosen the cataract and facilitate its issue." After the cataract was delivered the corneal flap was then allowed to fall into place. If the cataract happened to be soft and "glairy" or broken into pieces, the remnants were removed with a curette. The pupil might sometimes be disarranged by the passage of the lens, especially if it was large and hard, and it should then be readjusted. The corneal flap being accurately replaced, the eye was gently cleansed and covered with a small compress, over which plasters were applied and the whole was kept in place by a bandage without much pressure.

Daviel continued in his work, but his publications were limited. He defended his method of cataract extraction before the Royal Academy of Surgeons, his last paper being read by a friend on April 22, 1762. At this meeting he was unable to read the paper himself because of an illness in which his speech was impeded.

Soon after, he left Paris for different parts of France in an attempt to improve his health, finally going to Geneva. While there he took a violent purgative without the knowledge of his doctor and became very ill. He died on September 30, 1762, at the age of 69 years. There is evidence that he died of a cancer of the larynx. His wife, two sons, and several daughters were at home during this last illness, not realizing its severity. He was buried near Geneva. He has since been honored throughout France by many monuments and busts, commemorating his work.

It has been fascinating to read the earlier accounts on Daviel and the history of cataract surgery. Daviel's paper itself makes excellent reading. For those who do not read French, there is a full translation by Shastid in the *American Encyclopedia of Ophthalmology*. In reading this paper one can scarcely believe that it was written and presented 200 years ago.

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SOME PHENOMENA ASSOCIATED WITH AMBLYOPIA*

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Amblyopia is considered to be a lowered visual acuity not accounted for by an uncorrected refractive error or an abnormality in ocular structure. While the association of amblyopia with anisometropia and strabismus has long been recognized, the cause of amblyopia remains obscure.

It is one of the most frequent and serious visual problems in young individuals. Many of these encounter difficulties on seeking employment, applying for a driver's license, or during physical examinations for the Armed Forces. Downing[1] reported his figures for the incidence of amblyopia among 60,000 selectees for the U.S. Army in 1940. There were 855 cases of uniocular amblyopia without strabismus (1:70), 770 with esotropia (1:78), and 295 with exotropia (1:208). Thus, amblyopia is nearly as frequent among individuals with straight eyes as among strabismics.

All practicing ophthalmologists have managed scores of amblyopes. The diagnosis is usually not difficult and treatment follows accepted patterns. With our present state of knowledge, it is exceedingly difficult or even foolhardy to predict the results of therapy. There are many perplexing problems. It is the purpose of this report to attempt to answer the following questions which have confounded us.

1. Why do some amblyopes respond well to occlusion therapy while others do not?

2. How can we prognosticate which amblyopes will respond to occlusion therapy?

3. What determines the depth of amblyopia; that is, why does amblyopia in one patient stop at 20/70 while in another it is 20/400?

4. Do amblyopes use the same areas of the retina for fixation as normal individuals?

5. What is the status of the fovea in amblyopia?

These queries uncover an abyss of ignorance. Many investigators have offered theories which satisfactorily explain one phenomenon but contradict others. We shall attempt to offer a satisfactory solution to all these problems. In doing so, it will be necessary to review many elementary concepts. However, a great deal will be omitted lest we lose sight of the important points to be emphasized.

If, for some reason, binocular vision is undesirable (anisometropia, strabismus, and so forth), an adjustment may occur whereby the image of the strabismic or a more hypermetropic eye is minimized. If the visual acuity of this eye is lessened, the purpose is accomplished.

That this lessening of acuity is not the result of disuse alone (or possibly at all) is well known. Originally, many held the view that amblyopia was the direct result of disuse.

The percipient elements of the retina became nonfunctioning much the same as muscle fibers in the body atrophy from disuse. However, the percipient elements in these eyes are being stimulated at all times, but there is no cortical record made of this. It is also well known that a cataract extraction in an eye may restore vision in spite of the fact that the lens may have been opaque for years.

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Another theory is that the sensory pathways are intact in the amblyopic eye but the cortical centers will not accept the image from this eye. This will only explain suppression, not amblyopia. Suppression is a complete phenomenon. Suppression of vision down to 20/200, for example, does not occur; there must be a total loss. In alternating strabismus, at a given moment, one eye sees while there is a total absence of preception in the other eye. This is suppression.

Others have stated that there is, in addition to suppression, an active inhibition of the amblyopic eye. The nature of this is unknown.

Fixation in amblyopia

One of us (F. W. B.[2]) together with Dr. Isadore Givner has been investigating the nature of fixation in amblyopes in New York City. A report of this work appeared in the June, 1952, issue of the *Archives of Ophthalmology*. One of us (N. S. J.) has been carrying out an investigation along similar lines in the Ophthalmology Section of the U.S. Army Hospital, Fort Campbell, Kentucky.

It has been suspected for a long time that perhaps amblyopes do not use the fovea for fixation. We have all seen cases in which fixation on a muscle light revealed central corneal reflexes in both eyes but, when the good eye is covered, the amblyopic eye makes an excursion away from centration.

Fixation is eccentric in the amblyopic eye. Worth[3] commented on this more than a half century ago. An analogous situation is a patient with an acquired "hole in the macula."

The corneal reflection is central bilaterally as long as both eyes are open since binocular coördination exists. When the good eye is occluded, the poor eye moves to a position where the light can be best seen. Thus, the amblyope may act like the patient who has no fovea. We shall return to this point later.

Lazich,[4] in a paper entitled "Amblyopia ex anopsia: A new concept of its mechanism and treatment," which appeared in the February, 1948, issue of the *Archives of Ophthalmology*, suggested that amblyopia ex anopsia was due to "malprojection of the visual rays."

As a result of experiments with the corneal light reflex, where he showed that it was eccentrically placed in the amblyopic eye during fixation, he concluded that amblyopic eyes do not fixate with the true fovea but with an eccentric retinal area. He also noticed that, when asked to place his finger on the light, the patient rarely succeeded immediately since there is false projection.

Stereocampimetry revealed that the plotted blindspot in the amblyopic eye was displaced in a direction which coincided with the displacement of the visual axis from the fovea to an eccentric area.

Lazich further stated that the visual acuity in the amblyopic eye varied from one moment to the next because fixation was uncertain and wavering. He thus believed that amblyopia should be treated by attempting to correct the malprojection.

It must be admitted, however, that one cannot accurately determine one, two, or three degrees' eccentricity of fixation by the corneal reflex test. Also, stereocampimetry in the presence of an amblyopic eye is probably not sufficiently accurate to show minute displacements.

We have undertaken a technique to prove that an amblyope does not fixate with his fovea.

It is well known that an eye exposed to a vertical bar of light will experience an after-image after the stimulus has been removed.

It has also been shown that a sensation produced on the retina of one eye elicits a similar reaction on the corresponding retinal points in the other eye. This has been loosely referred to as the ability to "transfer" an after-image from one eye to the other. Actually what is really transferred is the awareness of an after-image. This is the basis of our test.

The patient is seated four feet from a

vertical bar of light (after-image tester). An occluder is placed over the amblyopic eye. Fixation is effected with the good eye on the central fixation dot of the after-image tester. This is maintained for 20 seconds (step 1, fig. 1). The patient then shifts his gaze to the central dot of the test chart (step 2, fig. 2) which is six feet away.

The chart is arranged much the same as a tangent screen. The central dot refers to the fovea. There are concentric rings which correspond to a certain distance from the fovea so long as the patient is six feet from chart. While the patient fixates the central dot with his good eye (amblyopic eye is covered), he will appreciate a vertical after-image which runs vertically "through" the dot. This part of the test is performed to make certain that the patient can appreciate an after-image.

The same procedure is repeated using the good eye for fixing the central dot on the after-image tester. However, the patient is now asked to fixate the central dot on the chart with his amblyopic eye while the good eye is covered (step 3, fig. 3).

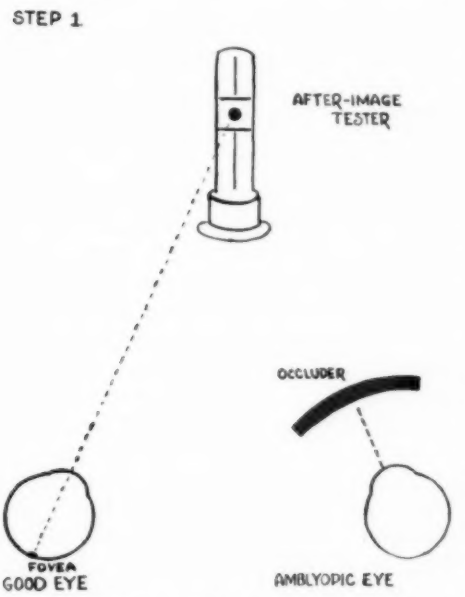

Fig. 1 (Jaffe and Brock). Amblyopic eye is occluded. Subject maintains fixation on fixation dot of an after-image tester with good eye for 20 seconds.

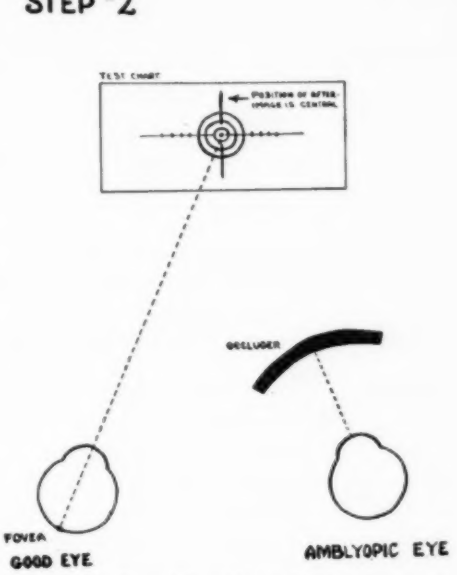

Fig. 2 (Jaffe and Brock). Amblyopic eye is still occluded. Good eye fixates the central dot of a test chart six feet away. Position of after-image will be reported as illustrated.

If both eyes are normal the patient will report that he again sees an after-image running vertically through the dot. This is so since corresponding points on the retinas are stimulated even though only one eye was exposed to the light.

For binocular awareness of an after-image to occur, there must exist a binocular integration; that is, correspondence must be present (normal correspondence is referred to simply as presence of correspondence while abnormal correspondence is referred to as noncorrespondence). Where no correspondence exists there is no awareness of the after-image in the nonexposed eye. Thus, when "transfer" occurs, correspondence must exist.

If the "transfer" occurs centrally, that is, the nonexposed eye reports the after-image as running vertically through the dot, we

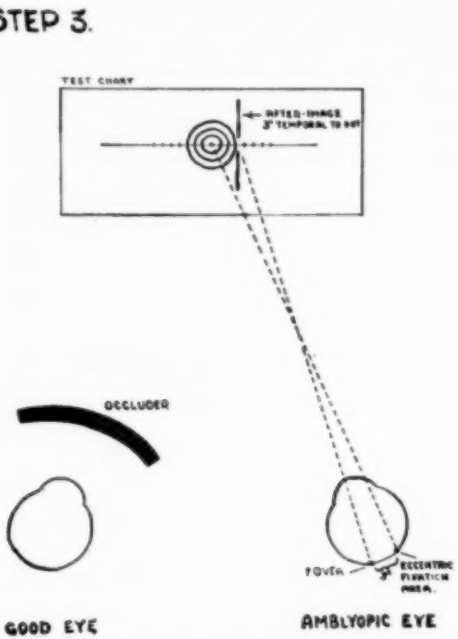

Fig. 3 (Jaffe and Brock). Good eye is occluded. Amblyopic eye fixates the central dot. The position of the after-image is reported. In the case shown here, the subject fixates with a point on the retina of his amblyopic eye three degrees eccentric to the fovea.

may assume that the nonexposed or second eye is fixing with the fovea. Since the vertical bar of light stimulated the fovea and points vertically above and below the fovea of the exposed eye, the after-image is "transferred" to these corresponding points in the second eye.

If the second eye uses its fovea to fixate the dot on the test chart, the vertical after-image will run up and down through the dot. If the second eye uses an eccentric retinal area for fixation, the patient will report the "transferred" after-image as being eccentric to the dot. This occurs since the after-image was "transferred" to his fovea (and points vertically above and below), that is, the corresponding points of the exposed eye.

If he does not fixate with the fovea of the second eye, he will not be aware of the after-image running through the dot on the chart. The dot refers to his fixation point (an eccentric retinal point) while the center of the "transferred" after-image refers to his fovea. The distance of the image from the central dot is read off in degrees and this is a measure of the eccentricity of fixation or the distance of the eccentric retinal point from the fovea.

This test was performed on the following groups of patients:

1. Poor visual acuity but correctible with lenses, that is, nonamblyopes. These represent control cases.
2. Anisometropic amblyopes.
3. Strabismic amblyopes.
4. Alternating strabismics with good visual acuity in both eyes.

The following results were obtained:

1. *Refractive errors in one or both eyes.* Forty such cases were tested; 39 or 97.5 percent were able to "transfer" the after-image from one eye to the other. In each case it was reported as passing through the dot, that is, central "transfer." One or 2.5 percent could not appreciate the after-image. In all these "control" cases, correspondence existed and there was no amblyopia. Fixation was central.

2. *Ansiometropic amblyopes.* Included here were 107 patients with an anisometropia of 1.25 diopters spherical equivalent or more. There were only three cases with a negative spherical equivalent, the remainder being positive. The average spherical equivalent in the amblyopic eye (104 cases with positive spherical equivalent) was +3.36 diopters while that in the good eye was +0.83, an anisometropia of +2.53 diopters.

Eighty-three patients or 78 percent showed an eccentric "transfer"; that is, the after-image was reported in the amblyopic eye as being to the left or the right of the central dot; 16 patients or 15 percent showed a central "transfer"; eight patients or seven percent could not "transfer" the after-image.

At this point suffice it to say that the great majority of anisometropic amblyopes

TABLE 1

ALTERNATING STRABISMICS WITHOUT AMBLYOPIA

Type	No.	Prism Diopters Average Deviation	Correspondence		Transfer	
			Normal	Abnormal	No.	Central
Esotropia	32	43	4 (12.5%)	28 (87.5%)	27	5 (4 had corres.)
Exotropia	16	45	8 (50.0%)	8 (50.0%)	8	8 (all had corres.)

do not fixate with the fovea of the amblyopic eye. Just which area of the retina they do use will be discussed later. The 15 percent who showed a central "transfer" are very interesting. They differ greatly from the eccentric "transfers."

Examination of their uncorrected visual acuities reveals, in 12 out of 16, a level of 20/200 to 20/1,000. In all 12 cases corrective lenses increased the vision to 20/80 to 20/40. This is in sharp contrast to the larger group whose uncorrected acuities are practically unaltered by corrective lenses. A typical case of each group is cited.

CASE 8

Uncorrected visual acuity: O.D., 20/20; O.S., 20/600. Corrected visual acuity: O.D., 20/20; O.S., 20/50. Refraction: O.D., +1.0D. sph. ⊃ +0.5D. cyl. ax. 180°; O.S., +5.0D. sph. ⊃ + 2.0D. cyl. ax. 15°. "Transfers" from right to left eye centrally.

CASE 75

Uncorrected visual acuity: O.D., 20/15; O.S., 20/600. Corrected visual acuity: O.D., 20/15; O.S., 20/600. Refraction: O.D., plano; O.S., +2.0D. sph. ⊃ +2.5D. cyl. ax. 90°. "Transferred" afterimage lies three degrees temporal to dot.

It will be shown later that other differences in these two groups exist. We shall conclude, therefore, that two different kinds of amblyopes exist.

3. *Alternating strabismics without amblyopia.* There were 48 patients with alternating strabismus included here. There were no amblyopes. The cases may be summarized as shown in Table 1. The conclusions here are obvious.

In order for a "transfer" to occur, a normal binocular pattern must exist. When correspondence is nonexistent (some prefer to use the term abnormal), the second eye is not aware of the after-image perceived by the exposed eye. If correspondence exists (normal correspondence), a "transfer" occurs. If there is no amblyopia, the "transfer" is central.

One patient should be mentioned to show the sensitivity of this as a test for a normal binocular pattern:

A dentist with 52 prism diopters of alternating exotropia demonstrated on his first visit a normal correspondence. He showed a central "transfer." On a subsequent visit he was not able to "transfer" and his subjective angle measured 24 prism diopters, the angle of anomaly being 28 prism diopters.

The status of the correspondence in all cases was determined by the troposcope and the vertical prism test. Bielschowsky's afterimage test was not used for reasons to be discussed later.

4. *Monocular strabismics with amblyopia.*

TABLE 2

MONOCULAR STRABISMICS WITH AMBLYOPIA

Type	No.	Prism Diopters Average Deviation	Correspondence		No.	Transfer	
			Normal	Abnormal		Eccentric	Central
Esotropia	86	38	54 (63%)	32 (37%)	37	49	0
Exotropia	12	42	9 (75%)	3 (25%)	4	8	0

Included in this category are 98 patients with a monocular strabismus and amblyopia in the deviating eye. The cases are summarized in Table 2.

Not one patient with noncorrespondence was aware of a "transferred" after-image. Five esotropes and one exotrope with demonstrable correspondence (normal correspondence) could not "transfer"; 49 out of 54 (91 percent amblyopic esotropes with correspondence showed an eccentric "transfer"; eight out of nine (89) percent amblyopic exotropes with correspondence showed an eccentric "transfer."

Thus, when a binocular pattern exists a "transfer" occurs. When amblyopia exists the "transfer" is eccentric. Which patients fixate with areas close to the fovea and which with areas more remote will form an important part of the present discussion.

Until now we have answered only one of our original questions—do amblyopes use the same areas of the retina for fixation as normal individuals? The answer is decidedly no! Amblyopes fixate eccentrically.

Depth of amblyopia

Why do different patients show different depths of amblyopia? We may assume that an eye will fixate with the retinal area affording the best visual acuity. This is the basis of the fixation reflex. If the acuity at the fovea is reduced below that of its surrounds, eccentric fixation will occur. In degenerative lesions of the macula, central fixation is lost. Eccentric fixation results, the patient using an area or areas of the retina with maximum acuity.

We have already determined that the great majority of amblyopes fixate eccentrically. We did not speak of the degree of eccentricity. An analysis of the data reveals a striking phenomenon. There is a direct relationship between the depth of amblyopia and the degree of eccentricity. The greater the eccentricity of "transfer" the deeper the amblyopia. Several examples will illustrate this.

Case 109

This anisometropic amblyope had a vision of 20/200, O.S., with and without his correction (+4.5D. sph.). He reported the "transferred" after-image 1.5 degrees nasal to the central dot with his left eye.

Case 13

This anisometropic amblyope had a vision of finger counting at three feet, O.S., with and without his correction (+1.25D. sph. $\bigcirc$ +1.5D. cyl. ax. 90°). He was aware of the after-image 4.5 degrees temporal to the dot with his left eye. In order to "see" the dot, he placed the tip of his finger on it.

Case 142

This anisometropic amblyope had an uncorrected vision of 20/70, correctible to 20/50 with a +6.0D. sph. $\bigcirc$ —1.0D. cyl. ax. 125°. He reported the "transferred" after-image 0.5 degree nasal to the dot with his left eye.

Case 19

This amblyope showed a left esotropia of 20 prism diopters. Vision, O.S., was 20/600 with and without correction (—6.5D. sph.). Correspondence existed (normal). He was aware of the after-image with his left eye four degrees temporal to the dot.

Case 120

This amblyope had 15 prism diopters of right esotropia. Vision, O.D., was 20/200 with and without correction (+1.25D. sph.). Correspondence existed. The right eye was aware of the "transferred" after-image 2.25 degrees temporal to the dot.

Case 43

This amblyope had 42 prism diopters of right exotropia. Correspondence existed. Vision, O.D., was 20/200 correctible to 20/100 with a +6.0D. sph. The left eye was exposed to the vertical bar of light and the right reported the after-image one degree nasal to the dot.

Note that the deeper the amblyopia, the greater is the eccentricity of fixation or, more correctly, the greater the eccentricity of fixation, the more profound the amblyopia.

Scobee[5] recently stated that it is unknown why amblyopia stops at a particular level in monocular esotropia. He states there is some unknown factor which determines this.

We know now that the depth of amblyopia is directly related to the eccentricity of fixation. Analysis of more than 200 amblyopes reveals that there is a direct linear relationship between the depth of amblyopia and eccentricity of fixation.

This observation is entirely supported by

anatomic and clinical data which are briefly summarized at this point.

Polyak[6] has shown that at the center of the fovea the cones are most closely packed; at this point, 60 cones could be placed side by side to cover a linear area of 0.1 mm. Only one degree from the center there are one-half as many or 30 cones in a linear area of 0.1 mm. At 2.5 degrees there are only 15 cones. Thus, a curve demonstrating this anatomic distribution would show the greatest decrease in cones within the first degree or so from the fovea. This corresponds with the decrease in visual acuity. There is a sharp fall in acuity immediately upon leaving the fovea and then a more gradual decrease peripherally.

The original study of the visual acuity of peripheral portions of the retina was carried out by Wertheim.[7] More recent experiments indicate that his visual-acuity values may have been too high. However, his observation that the drop in acuity is very rapid at first and then less rapid as the periphery is reached remains unchallenged. Wertheim's curve shows a rather steep drop between the fovea (acuity 1.00) and 2.5 degrees (acuity 0.46).

Jones and Higgins[8] carried out studies between 0 axis and one degree using Landolt rings. They showed:

Degrees from Fovea		Acuity
1/17°	=	0.95
1/12°	=	0.92
1/6°	=	0.75
5/6°	=	0.40

Thus, 20/50 vision was reached before the one-degree axis was attained.

Further studies by Luckiesh and Moss[9] show lower acuity values more peripherally than Wertheim indicated:

Degrees from Fovea		Acuity
2.9°	=	0.20
3.6°	=	0.15
5.8°	=	0.10
12.0°	=	0.05

Results differ according to the test method. For example, Brock[10] showed that the values were higher (equal to Wertheim values) if the test consisted of ability to distinguish two parallel lines. They were lower if recognition of letters or symbols were required.

Thus far, we have shown that amblyopes fixate eccentrically and the greater this eccentricity the deeper the amblyopia. At this point one is justified in asking why this eccentricity is not more obvious in amblyopes. The answer is that we are dealing with eccentricities of small amounts, up to four degrees. One must be especially keen to diagnose 1, 2, 3, or 4 degrees of displacement of the corneal light reflex.

Status of the fovea

Our next task is to prove that the fovea and those areas central to the eccentric area have a lower acuity gradient than the eccentric area in question. We should expect to find a scotoma, absolute or relative. It is not easy to demonstrate a scotoma of one or two degrees. We have used a simple test which proves quite satisfactory.

In performing the after-image "transfer" test the amblyopic eye is aware of the vertical after-image, let us say, two degrees to the right of the central dot. A retinal area two degrees eccentric to the fovea is being used. The after-image coincides with the fovea, and the fixation dot represents the projection of the eccentric fixation point.

If we now ask the patient to look two degrees to the left of the dot, the after-image will now be superimposed on the dot of the chart. Thus, the central dot represents the projection of the fovea (figs. 4 and 5).

This test was performed on 52 anisometropic amblyopes who showed eccentric "transfers." It was also performed on 47 monocular strabismic amblyopes, all of whom showed an eccentric "transfer."

Four types of responses were observed:

1. Central dot remained visible. This indicates a functioning fovea. Nine patients or 9.1 percent gave this response.

2. Central dot disappeared completely when the contraocularly induced after-image

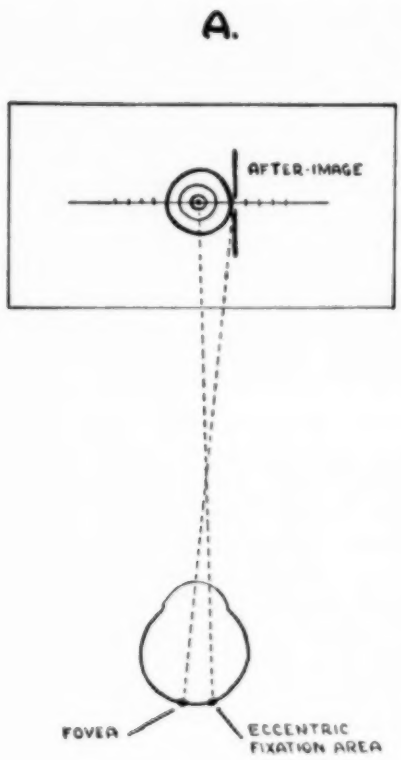

Fig. 4 (Jaffe and Brock). Amblyopic eye fixes central dot and notes that the "transferred" after-image lies three degrees to the right of the dot.

was superimposed on it. This indicates an absolute foveal scotoma. Forty-three patients or 43.4 percent gave this response.

3. Central dot became dim. This indicates a small or relative scotoma. Thirty patients or 30.3 percent gave this response.

4. The dot was seen at first and then became dim or even disappeared. This may represent a transient phase. Seventeen patients or 17.2 percent reported this.

Apparently, whether the amblyopia is associated with strabismus or with simple anisometropia has no bearing on the type of responses. The four types are rather evenly distributed in both groups.

At this point we may say that the great majority of amblyopes who show an eccentric "transfer" can be shown to exhibit a scotoma in the most central area. The practical application of this will be shown later.

Response to occlusion therapy

In order to determine how the foregoing might influence therapy, the following project was undertaken. Twenty patients were subjected to occlusion therapy. All 20 cases will be cited and then summarized.

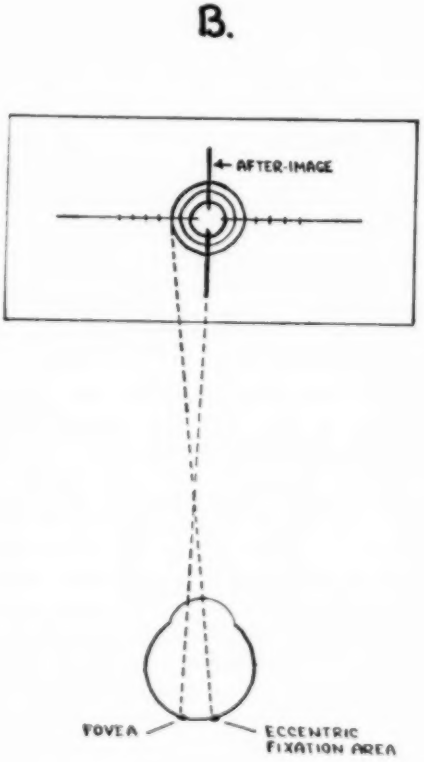

Fig. 5 (Jaffe and Brock). Amblyopic eye fixes three degrees to the left of the dot so that the after-image will be superimposed on the central dot. If the central dot disappears, a foveal scotoma exists.

CASE 50

Amblyopic anisometrope, aged 19 years. Vision, O.D., 20/20; O.S., 20/400. Refraction: O.D., +0.5D. sph.; O.S., +2.5D. sph. ⊃ +1.0D. cyl. ax. 165° = vision still 20/400. After-image lies 2.5 degrees temporal to dot with left eye. Absolute central scotoma. Total occlusion: O.D., May 17, 1952, to August 1, 1952. Vision, O.S., 20/400.

CASE 82

Amblyopic anisometrope, aged seven years. Vision, O.D., 20/20; O.S., 20/200. Refraction: O.D., plano; O.S., +4.0D. sph. = 20/200. After-image lies two degrees nasal to dot with left eye. Absolute central scotoma. Total occlusion, O.D., May 5, 1952, to July 31, 1952. Vision, O.S., 20/100.

CASE 95

Amblyopic anisometrope, aged 22 years. Vision, O.D., 20/20; O.S., 20/50. Refraction: O.D., +0.25D. sph. ⊃ +0.5D. cyl. ax. 90° = 20/15; O.S., −0.5D. sph. ⊃ +4.5D. cyl. ax. 75° = 20/40. After-image lies 0.25 degrees nasal to dot with left eye. Absolute central scotoma. Total occlusion, O.D., April 20, 1952, to June 30, 1952. Vision, O.S., 20/40.

CASE 32

Amblyopic anisometrope, aged six years. Vision, O.D., 20/15; O.S., 20/60. Refraction: O.D., +0.7D. sph.; O.S., +5.0D. sph., vision still 20/60. After-image lies 0.75 degrees nasal to dot with left eye. Scotoma is relative. Total occlusion, O.D., April 20, 1952, to June 30, 1952. Vision, O.S., 20/60.

CASE 79

Amblyopic anisometrope, aged 19 years. Vision, O.D., 20/20; O.S., 20/60. Refraction: O.D., plano; O.S., —0.5D. sph. ⊃ +4.5D cyl. ax. 60° = 20/50. After-image lies 0.5 degrees nasal to dot with left eye. Scotoma is relative. Total occlusion, O.D., May 5, 1952, to August 1, 1952. Vision, O.S., 20/25.

CASE 23

Amblyopic anisometrope, aged six years. Vision, O.D., 20/200; O.S., 20/25. Refraction: O.D. +3.0D. sph. = 20/200; O.S., +0.75D. sph. ⊃ +0.25D. cyl. ax. 90° = 20/20. After-image lies 2.5 degrees temporal to dot with right eye. Scotoma is relative. Total occlusion, O.S., May 17, 1952, to July 27, 1952. Vision, O.D., 20/100.

CASE 4

Amblyopic anisometrope, aged 22 years. Vision, O.D., 20/200; O.S., 30/30. Refraction: O.D., +1.75D. sph. ⊃ +3.0D. cyl. ax. 45° = still 20/200; O.S., +0.5D. sph. ⊃ +2.25D. cyl. ax. 150° = 20/20. After-image is eccentric but is not fixed. It varies between 0.5 degree and three degrees temporal. Scotoma test—dot seen clearly at first, then became dim. Total occlusion, O.S., May 1, 1952, to July 28, 1952. Vision, O.D., 20/40.

CASE 111

Amblyopic anisometrope, aged eight years. Vision, O.D., 20/20; O.S., 20/200. Refraction: O.D., +0.5D. sph. ⊃ +1.0D. cyl. ax. 90° = 20/15; O.S., +6.0D. sph. = still 20/200. After-image varies between 0.0 and two degrees nasal to dot. Scotoma test—dot seen clearly at first, then became dim. Total occlusion, O.D., April 27, 1952, to August 1, 1952. Vision, O.S., 20/50.

CASE 143

Amblyopic anisometrope, aged 20 years. Vision, O.D., 20/20; O.S., 20/200. Refraction: O.D., +2.5D. sph.; O.S., +4.5D. sph. = 200/100. After-image varies between 0.5 and two degrees nasal to dot. Scotoma test—dot seen clearly at first, then became dim. Total occlusion, O.D., May 17, 1952, to July 31, 1952. Vision, O.S., 20/40.

CASE 8

Amblyopic anisometrope, aged 18 years. Vision, O.D., 20/20; O.S., 20/600. Refraction: O.D., +1.0D. sph. ⊃ +0.5D. cyl. ax. 180° = 20/20; O.S., +5.0D. sph. ⊃ +2.0D. cyl. ax. 15° = 20/50. "Transfers" after-image centrally, that is no eccentric fixation. Total occlusion, O.D., May 3, 1952, to August 1, 1952. Vision, O.S., 20/20.

CASE 34

Amblyopic anisometrope, aged nine years. Vision, O.D., 20/20; O.S., 20/300. Refraction. O.D., +0.75D sph.; O.S., +2.5D. sph. ⊃ +1.25D. cyl. ax. 180° = 20/60. "Transfers" after-image centrally. Total occlusion, O.D., April 20, 1952, to July 1, 1952. Vision, O.S., 20/25.

CASE 91

Amblyopic anisometrope, aged 23 years. Vision, O.D., 20/20; O.S., 20/200. Refraction: O.D., plano; O.S., +2.0D. sph. ⊃ −4.5D. cyl. ax. 180° = 20/40. "Transfers" after-image centrally. Total occlusion, O.D., May 3, 1952, to August 2, 1952. Vision, O.S., 20/15.

CASE 132

Amblyopic anisometrope, aged 20 years. Vision: O.D., 20/200; O.S., 20/20. Refraction: O.D., +2.5D. sph. ⊃ +0.5D. cyl. ax. 90° = 20/40; O.S., +1.0D. "Transfers" after-image centrally. Total occlusion, O.S., May 1, 1952, to July 25, 1952. Vision, O.D., 20/20.

CASE 146

Amblyopic anisometrope, aged 11 years. Vision, O.D., 20/15; O.S., 20/300. Refraction: O.D., +0.75D. sph.; O.S., —2.75D. cyl. ax. 180° = 20/40. "Transfers" after-image centrally. Total occlusion, O.D., May 10, 1952, to July 2, 1952. Vision, O.S., 20/15.

CASE 166

Right esotropia, aged eight years. Vision, O.D., 20/200; O.S., 20/20. Refraction: O.D., +1.25D. sph. = 20/100; O.S., +0.5D. sph. Right esotropia 40 prism diopters. Correspondence exists. After-image lies two degrees temporal to dot with right

eye. Absolute central scotoma. Total occlusion, O.S., May 3, 1952, to July 28, 1952. Vision, O.D., 20/100.

CASE 69

Right esotropia, accommodative, aged 18 years. Vision, O.D., 20/200; O.S., 20/20. Refraction: O.D., +2.0D. cyl. ax. 170° = 20/100; O.S., +3.75D. sph. Right esotropia 30 prism diopters without correction, 0.0 with correction. Correspondence exists. After-image lies two degrees temporal to dot with right eye. Absolute central scotoma. Total occlusion, O.S., April 7, 1952, to July 21, 1952. Vision, O.D., 20/100.

CASE 26

Left exotropia, aged 21 years. Vision, O.D., 20/20; O.S., 20/80. Refraction: O.D., plano; O.S., +1.5D. sph., still 20/80. Left exotropia 60 prism diopters. Correspondence exists. After-image lies one degree temporal to dot with left eye. Relative central scotoma. Total occlusion, O.D., May 14, 1952, to August 1, 1952. Vision, O.S., 20/70.

CASE 67

Left esotropia, aged 21 years. Vision, O.D., 20/40; O.S., 20/100. Refraction: O.D., −0.75D. sph. ⊃ −0.5D. cyl. ax. 15° = 20/20; O.S., −1.25D. sph., vision still 20/100. Left esotropia 16 prism diopters. Correspondence exists. After-image varies between 0.5 to three degrees temporal to the dot with left eye. Scotoma test—dot clearly visible at first, then became dim. Total occlusion, O.D., June 1, 1952, to August 2, 1952. Vision, O.S., 20/40.

CASE 128

Right esotropia, aged 20 years. Vision, O.D., 20/300; O.S., 20/20. Refraction: O.D., +0.5D. sph. ⊃ −1.0D. cyl. ax. 90°, vision still 20/300; O.S., +0.25D. sph. Right esotropia 26 prism diopters. Correspondence exists. After-image varies in position from three degrees temporal to three degrees nasal to dot with right eye. Scotoma test—dot clearly visible at first, then became dim. Total occlusion, O.S., May 17, 1952, to July 5, 1952. Vision, O.D., 20/60.

CASE 78

Right esotropia, aged 20 years. Vision, O.D., 20/200; O.S., 20/25. Refraction: O.D., −1.5D. cyl. ax. 180°; vision still 20/200; O.S., −0.75D. cyl. ax. 165° = 20/20. Right esotropia 16 prism diopters. Correspondence exists. After-image varies from 0.5 to four degrees temporal to the dot with the right eye. Scotoma test—dot clearly visible at first, then became dim. Total occlusion, O.S., May 2, 1952, to August 1, 1952. Vision, O.D., 20/50.

There are certain striking conclusions which may be drawn from these 20 cases. It has been observed by many that occlusion therapy is occasionally successfully in individuals who are in the third or even fourth decades of life. Apparently they represent a different kind of amblyopia. We now know how they differ from other cases of amblyopia.

Recall that out of the 107 anisometropic amblyopes already referred to, only 16 (15 percent) showed a central "transfer." Only 15 percent retained foveal fixation; that is, no central scotoma existed.

Also note that 12 of these cases had uncorrected acuities ranging from 20/200 to 20/1,000. With correction, the acuities increased to a range between 20/40 and 20/80. This differed from the other amblyopes in whom uncorrected and corrected acuities were almost identical.

Note further that five of these patients were offered occlusion therapy and all five showed an increase to normal acuity (Cases 8, 34, 91, 132, and 146). We consider these patients to show the real amblyopia ex anopsia. They are in the minority among amblyopes. They have no foveal scotoma, thus they retain central fixation. They respond well to occlusion at any age.

We further offer that all other amblyopes are "true amblyopes." In all, there is a drop in foveal acuity. Whether this foveal defect is due to a hemorrhage in the fovea at birth or some other mechanism, we are not prepared to say. Almost all of these amblyopes are obliged to resort to fixation with eccentric retinal areas where the acuity gradient is higher than at the fovea. The larger the scotoma, the greater the eccentricity of fixation. It is rarely greater than four degrees.

We have felt that there were differences even among these "true amblyopes." Some show an eccentric "transfer" which is fixed; that is, it measures the same amount from moment to moment and from day to day. Others will report the "transferred" after-image to move continuously and never remain fixed. In addition to this, the central scotoma test revealed certain differences. Some have absolute central scotomas, some

relative, and in some the dot is seen clearly at first and then becomes dim.

In order to determine what value these responses have in prognosticating the results of therapy, representative patients were subjected to occlusion therapy.

Cases 50, 82, and 95 showed a fixed eccentric fixation with an absolute central scotoma. Occlusion was a failure in all three. Cases 32, 79, and 23 showed a fixed eccentric fixation with a relative central scotoma. Only Case 79 responded well to occlusion.

Cases 4, 109, and 143 had the following in common. The eccentric fixation area varied continuously and all three saw the dot clearly at first in the scotoma test and then reported difficulty in seeing it. There was a good response to occlusion in all three, although not as good as in the five cases of "amblyopia ex anopsia."

Cases 166 and 69 were esotropic amblyopes who showed a definite fixed eccentric fixation point. There was an absolute scotoma in both. Occlusion therapy was a failure in both.

Case 26 was an exotrope with a fixed eccentric area but a relative scotoma. Occlusion was fruitless.

Case 67, 128, and 78 were esotropic amblyopes all in the third decade of life. In all three the eccentric fixation was variable and the central dot was clearly seen at first and then became dim. In all three, occlusion provided a marked increase in vision although not to normal.

We may boldly state that occlusion will probably result in failure when the eccentric retinal area is fixed and when there is an absolute central scotoma. We may expect gratifying results when the scotoma is very minute and when the eccentric fixation area is not fixed. The best results are obtained in cases of amblyopia ex anopsia where central fixation is retained.

The final point to be offered by this presentation concerns methods of testing for anomalous correspondence. Recall that the status of correspondence in the strabismics herein reported was determined with the troposcope and the vertical prism test. Bielschowsky's[11] after-image test was not used because it has often given erroneous and confusing results.

Consider the following. If a vertical bar of light is offered to one eye and then a horizontal bar to the other eye, the after-image should form a perfect cross if correspondence exists and if both foveas are used to fixate the light. However, in the case of a "true amblyopia," the amblyopic eye uses an eccentric retinal area for fixating the light.

The after-image thus formed is not a true cross. If there are three degrees of eccentricity, the vertical after-image will intersect the horizontal three degrees off center. We may erroneously refer to this as abnormal correspondence.

Summary

1. Solutions to some of the problems associated with amblyopia are offered for consideration.

2. There are two types of amblyopia, amblyopia ex anopsia and "true" amblyopia. The former is infrequent, representing about 20 percent of all cases of amblyopia.

3. "True" amblyopes lose the ability to fixate with the fovea, while central fixation is retained in amblyopia ex anopsia.

4. The depth of amblyopia in "true" amblyopia is determined by the eccentricity of fixation. This may be anywhere from 0.125 degree to 3.5 or 4.0 degrees from the fovea.

5. The degree of eccentricity is determined by the size of the central scotoma.

6. Amblyopes who retain central fixation respond well to occlusion therapy at any age. Those with an established eccentric fixation and an absolute foveal scotoma respond poorly to occlusion. When fixation varies between central and eccentric or when the eccentric point shifts from moment to moment, occlusion may be of benefit. When the foveal scotoma is relative, occlusion is often of benefit.

7. Numerous cases are presented to illustrate all points. This report comprises a study of 107 anisometropic amblyopes, 98 strabismic amblyopes, 48 alternating strabismics without amblyopia, and 40 patients with correctible refractive errors.

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RESIDUAL ACCOMMODATION*

A METHOD FOR ITS OBJECTIVE DETERMINATION: WITH AN ANALYSIS OF SEVERAL DIFFERENT CYCLOPLEGICS, ESPECIALLY HOMATROPINE (FIVE PERCENT) IN METHYLCELLULOSE AND ZEPHIRAN

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Residual accommodation is a term coined to indicate the amount of accommodation remaining in an eye which is supposedly under the maximum influence of a cycloplegic drug. Throughout the years, this condition has been referred to usually "just in passing." In only a few instances, excerpts have been found which mentioned methods for determining the amount of residual accommodation. These methods were practically always subjective. Duke-Elder does mention the possibility of doing an objective test for determining residual accommodation.

Beach in discussing Swan and White's paper on "Dibutoline sulfate," made the following statement: "Much of the recent work on cycloplegia has been unconvincing because of questionable measurement of accommodation; while none of the tests were entirely satisfactory."

Feldman in his article on mydriasis felt that, because the test used was subjective, there were several shortcomings in his attempt to determine the amount of residual accommodation.

Jackson in his book on *Skiascopy*, the fourth edition which was published in 1905, makes the following statement: "The objective determination of the nearest point for which the eye can be focused is possible only by skiascopy. The test is of practical value in recognizing any slight remaining accommodation after the use of a mydriatic."

Sheard stated: "All subjective tests should be supplementary to investigations by objective methods. . . . Whenever possible, objective methods should be devised and used even though they may have their probable or apparent inherent source of error."

RÉSUMÉ OF SUBJECTIVE TESTS USED

During a recent investigation of several different cycloplegic drug combinations, it

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was necessary to use a test for residual accommodation to evaluate the maximum effect of these cycloplegics. At that time the only test for residual accommodation I knew was a subjective test for the near point.

Briefly, the subjective test used in this investigation with five-percent homatropine in zephiran and methylcellulose consisted of placing a +3.0 D. lens in the trial frame in addition to the distance correction, having the patient watch the letters on the Prince-rule card and tell the examiner when the letters went out of focus as the card was moved toward him. This was Test 2 in the series. It proved to be unsatisfactory.

Test 1 included the same equipment but, instead of Test 2, the Prince-rule card was placed closer to the patient than his near point and slowly moved away to stop when the letters came into focus. It soon became apparent that these particular subjective tests for the near point were unsatisfactory because one could not rely on the patient giving a correct and prompt response. There were very few who would consistently stop on the same point after several trials. Practically all patients would "skid" by the near point, consequently, an objective method for determining residual accommodation had to be devised and tried.

Test 3 was the objective method devised with the use of the retinoscope and a target letter "E" which was mounted on the top of the retinoscope for stimulating any residual accommodation.

Résumé of objective tests used

Different ideas in regard to objective methods were tried. Early in the series one test which was tried was a monocular one. It was unsatisfactory because the eye not being examined was occluded. It was later found that it was not necessary to occlude one eye. To do the test as a binocular one was not only easier but more in keeping with other objective procedures.

In another group of cases, a three and four-mm. aperture was used in front of the eye examined. It was thought that, possibly, the dilated pupil might alter the true findings. This idea was soon discarded in favor of waiting for the full pupillary area to fill with the "with" motion of the retinal reflex (this will be described later).

The laboratory procedure of having the patient watch a pin through a pinhole aperture as it approached the eye under examination with the retinoscope was found to be too difficult for patients to understand; they were confused by how to watch for the pin to become "double."

Finally, the binocular test which was used in this work was found to be very reliable, easy to do, and simple for the patient to understand. As a matter of fact, it is so flexible for variations that it is a big help in evaluating retinoscopic findings in youngsters under five years of age and in illiterate patients.

Basis of this work

The following is a direct description of Sheard's method of determining amplitudes of accommodation and is included here because it forms the basis of this work:

"The patient draws the test object as near the eye as will still permit of its reading. To the examiner at 13 inches the skiascopic reflex will show an 'against' or 'myopic' condition indicating that he is outside of the optical far point dynamically considered. The operator then moves forward until he obtains the neutral shadow position. The test object is then to be carried still closer to the eye (blurred image makes no difference) and the nearest point of neutral shadow found and measured. This gives the apparent near point under whatever ocular conditions the test is made (ordinarily when wearing the distance correction) and from it the range and amplitude of accommodation are easily determined."

Description of procedure

The procedure used in making this objective determination of residual accommo-

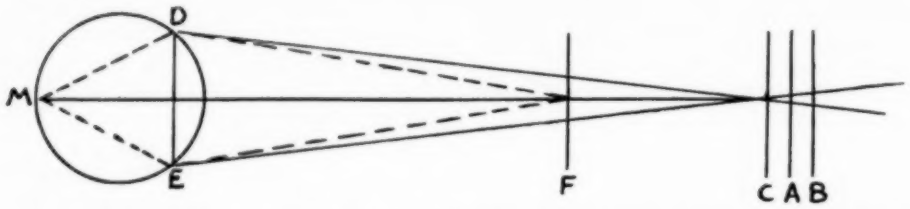

Fig. 1 (Rasgorshek). (F) Test object. (A) Position for examiner. Example: D. F.—10 inches (4.0D.); D. A.—13 inches (3.0D.) Conclusion: Only 3.0D. of accommodation available at 10 inches. Indication: 1.0D. of lenticular assistance.

dation is Test 3 in the work herein reported. The cycloplegics used in this series were homatropine (five percent) in 1:5,000 zephiran and homatropine (four percent in buffered methylcellulose and zephiran. One drop in each eye was used in each case.

The patient is instructed to turn his eye down while the drop is being placed above the superior limbus. The examination is done at the end of 30 minutes.

The distance refraction is left in the frame and then the determination of the residual accommodation is started. After the two subjective methods have been used the +3.0D. lens is retained in the trial frame.

This objective test is done with both eyes open. The patient is made familiar with a target letter "E" which is mounted on top of the retinoscope as it is brought from the distance blurred area into the focal distance.

While the patient is looking for this target letter "E" to come into focus, the examiner is constantly watching the fundus reflex in the pupil through the retinoscope. Starting from beyond the far point of the eye, the fundus reflex in the patient's pupillary space is noticed to be going in "against" fashion.

As the examiner moves toward the patient and eventually arrives at the far point of the eye under cycloplegia the fundus reflex takes on a very noticeable change in its movements and brilliance. It becomes more brilliant and the "against" motion is partially lost, but not completely. Early in this work, this point was a bit confusing. In other words, for several months, the examiner was using this change in fundus reflex as the criterion for making the residual accommodation determination. Consequently, practically 100 percent of the cases were showing an apparent residual accommodation of zero.

After further inquiry and further use of this procedure, it was noticed that other things were also occurring in regard to this fundus reflex as observed through the retinoscope in the pupillary space. It was noticed that there still remained some "against" motion in the reflex, and so it was decided to carry the test in closer toward the patient, always watching this fundus reflex until such time as the motion was entirely "with" and no "against" motion remained in the periphery of the reflex.

The far point is the factor involved at this stage and requires consideration and speculation. It, of course, is artificially produced by the addition of the +3.0D. lens to the distance correction. It is necessary to keep this in mind when estimating the residual accommodation.

If the patient is told to continue watching the target letter "E" as it is moved in closer to the eye and at the same time the fundus reflex is kept under observation through the retinoscope, the following result is obtained.

The target letter "E" remains in focus until it arrives at a point 15 cm. from the eye which is equal to six diopters—this focal change occurs abruptly and in practically every case regardless of the age group.

Since using this procedure of following the fundus reflex until the pupillary space is completely filled with "with" motion, there

has been a noticeable improvement in correlation of Test 1 with Test 3.

Test 1—test card on Prince rule going away from patient
Test 2—test card on Prince rule coming toward the patient
Test 3—Skiascopy (objective)

Test 1 is the test used with the small letter target card on the Prince rule starting it closer than the near point of the eye and slowly moving it away from the patient's eye, instructing the patient to tell the examiner when the letters in the middle line of the target come into clear focus. In a relatively high percentage of instances, this test has been found to compare favorably with Test 3.

Test 2 is the test used with the small letter target card on the Prince rule starting it farther away than the far point of the eye and slowly moving it toward the patient's eye, instructing the patient to tell the examiner when the letters in the middle line of the target card go out of clear focus. This test proved unsatisfactory and was discarded early in the work.

Test 3 is the objective test in which the retinoscope is used for observing the fundus reflex while stimulating any residual accommodation. This has been described in detail in a previous paragraph.

So far, discrepancy between the two tests, that is Test 1 and Test 3 against Test 2 has been explained on a basis of "depth of focus" as suggested by Copeland.

Evaluation of procedure

After using this objective procedure in determining the presence or absence of residual accommodation in a sufficient number of cases, it became necessary to establish the procedure by comparing results of different cycloplegics (Table 1). At the same time, it was possible and interesting to include the several groupings of the patients according to their refractive error and age limits.

By way of explanation, this investigation was done entirely with private patients and therefore there were varying numbers of patients in the different groups. It seemed that it would be better to do this investigation just as a routine part of refraction examinations—which it has now become. It actually does not add two minutes to the examination time.

As has been stated previously, the drops which have proven the best and are now used routinely, are the five-percent homatropine in methylcellulose and zephiran. In the series using the alkaloid of homatropine in castor oil (table 1) excessive irritation and congestion caused the patients to complain bitterly of pain immediately after the oily drops crossed the superior limbus onto the

TABLE 1

Averages for residual accommodation

	Hyperopia Group 1 0.0D. to +1.0D.	Hyperopia Group 2 +1.25D. to +2.5D.	Myopia Group 1 0.0D. to −1.0D.	Myopia Group 2 −1.25D. to −2.5D.	Myopia Group 3 −2.75D. to −4.0D.	Compound Hyperopic Astigmatism	Compound Myopic Astigmation	Mixed Astigmatism	Totals
Total patients	187	55	28	13	2	231	32	107	655
Alkaloid of homatropine in oil	+1.52	+1.4	+1.68		+0.62	+1.8		+1.00	+1.5
Homatropine and paredrine	+0.94	+0.90	+1.34			+0.94	+0.92	+1.22	+1.06
Alkaloid of homatropine and cocaine in oil	+1.22	+0.81	+1.35			+0.91	+1.35		+0.98
Homatropine in methylcellulose and zephiran	+0.57	+0.57	+1.3	+0.28		+0.5	+0.21	+0.63	+0.57
Age limits (yr.)	7 to 50	7 to 55	7 to 44	8 to 45	23 to 28	6 to 60	10 to 52	8 to 52	6 to 60
Age average (yr.)	28	30	26	26	25	30	29	29	29

cornea. This situation was not only relieved by adding cocaine to the solution, but the efficiency of the drops was increased considerably (table 1).

Using homatropine (five percent aqueous solution) and paredrine did not give as good results in this investigation as homatropine and cocaine alkaloids in castor oil or homatropine in methylcellulose and zephiran (table 1).

The only reason for discontinuing the oil drops was because of the complicated technique for preparing them; and also the solution with zephiran remained in better condition over a longer period of time as far as resisting contamination. Apparently the methylcellulose does as well as castor oil in providing a good "contact" film for the cornea. In addition to that, the zephiran probably aids in absorption by lowering the surface tension of the solution.

On several occasions it seemed necessary to check the refraction which was done with homatropine (five percent) in methylcellulose and zephiran. Atropine (one percent) was used for three days before the test, as had always been done. In every case, the atropine was of no help.

Summary

During this investigation many situations have arisen which suggested different practical applications of this test in regard to residual accommodation.

1. It seems likely to be of value in low refractive errors. In these cases there are many instances in which it is difficult to evaluate the necessity of correcting the refractive errors. With the aid of the objective residual accommodation test, we now have a means of satisfying ourselves as to the necessity of using low refractive error correction.

2. It has seemed as if patients with low refractive errors and low residual accommodation, after being rechecked by a postcycloplegic test, have been helped by full correction. As a result of this correlation, residual accommodation has taken a new aspect—that is, it is regarded as capable of demonstrating the amount of "reserve accommodation." By the same reasoning, corrective lenses are not given for low errors associated with a high residual accommodation.

3. In another large group, the myopic cases, which have always raised doubts as to whether they were being overcorrected, uncertainty is removed. If the point of reversal is found to be outside or beyond the far point, it is immediately obvious that the case has been overcorrected. This point has, in every instance, been corroborated by further checking.

4. In this same group of myopia cases, more than just the occasional patient complains of headaches. Quite frequently, this objective residual accommodation test will reveal +1.0D. to +1.5D. residual accommodation. By adding more minus proportionately to the present distance correction, this complaint is relieved.

5. On the postcycloplegic reëxamination, residual accommodation, when regarded as an indication of "reserve accommodation," is of value as a guide for reducing the total correction as found under cycloplegic.

6. Coincidentally, a cycloplegic—homatropine (five percent) in methylcellulose and zephiran has been proven efficient for a 30-minute period. Many of the cases were examined as late as 90 minutes after the instillation and found to have a residual accommodation averaging around +0.50 diopter.

Conclusion

An objective procedure for determining residual accommodation during a cycloplegic examination has been described. A new cycloplegic combination has been suggested. The time for maximum effect of the cycloplegic has been reduced to 30 minutes. This is desirable because patients always complain about having to wait for several hours after drops are instilled before refraction can be done.

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PREVENTION OF INFECTION IN OPHTHALMIC SURGERY: FURTHER STUDIES*

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On several previous occasions, this subject has been presented by me before this society.[1, 2] Other papers and discussions have been published elsewhere.[3-5] The matter, however, is of sufficient importance to be presented once more. The major part of this paper deals with certain new developments which are of considerable interest. The details of former studies will not be entered into. Suffice it to call attention to the fact, as previously stated:

> Consideration of all the possibilities shows that infection in ophthalmic surgery takes place from:
> A. Endogenous sources, such as (1) systemic infection (lues, tuberculosis, septicemia, acute exanthemata, both in the active stage and during the incubation period, or even during convalescence); (2) foci of infection (apical abscesses in the teeth, pyorrhea, and so forth, infected tonsils, accessory nasal sinus disease, and prostatitis); (3) latent phaco-anaphylaxis.
> B. Exogenous sources, such as (1) contamination residual in the conjunctiva, glands of the lids, lacrimal apparatus, and skin; (2) the hands and gloves of the surgeon, assistant, and nurses; (3) droplet infection through the masks of participants; (4) dustborne organisms.

Only a consideration of methods for the prevention of infection resulting from contamination of the instruments used in intraocular operative procedures will be considered. It is obvious that not only must the instruments be sterilized, but that sterility must be maintained, in so far as possible, throughout the period of the operative procedure.

There are many methods by which instruments may be sterilized, such as boiling in water, heating in dry air, heating in mineral oil. But the use of chemical solutions is far the simplest measure, provided that satisfactory solutions can be found, ones that will not only sterilize the instruments, but also preserve their original condition free from injury, such as that resulting from corrosion from chemical reaction. Such reactions may take place, not only between different instruments made of different metals, but also between the handle and the blade of the same instrument.

These facts have been widely recognized. A recent communication from a leading Swiss eye-instrument manufacturer includes suggestions for sterilization, carrying the names of such authorities as Vogt and Barraquer, listing complicated suggestions for sterilizing instruments made of different materials.

This complexity can be obviated by the use of the solution developed by me and described in a paper published by Mr. William Moor, bacteriologist to the Department of

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Ophthalmology, of Washington University School of Medicine, and me in the AMERICAN JOURNAL OF OPHTHALMOLOGY.[4]

This solution has been proved not to set up such electrolytic reactions in any of the various metals which are used in the manufacture of ophthalmic surgical instruments, even when large numbers are sterilized at the same time in the same container, provided the use of certain plastics is avoided. Demonstrating this fact, three knives with handles made of different metals have been exposed to its action continuously, in the same container, without injury, for a period of 10 years.

The formula for the solution, known as No. 4, may be written:

Liquor cresolis compound	8.0 cc.
Oil of lavender	2.0 cc.
Thymol crystals	2.0 gm.
Ethyl alcohol 95 percent	88.0 cc.

It has been demonstrated that clean instruments contaminated by cultures made up of various types of virulent organisms can be sterilized by immersion in the above solution for a period of one-half minute. Four and one-half minutes, however, are required to sterilize others, previously soiled by blood and serum, when contaminated by the same cultures, plus a heavy concentration of spore-bearing hay bacilli.

Repeated experiments since this solution was originally proposed have continued to give similar results, so that, without qualification, I can state that this solution will definitely sterilize all instruments allowed to remain in it for a period of five minutes, with the possible exception of certain strains of highly resistant spores, which are seldom, if ever, met with in any form of surgery.

This solution has been in routine use by the Department of Ophthalmology, Washington University School of Medicine, since February 1, 1944. It has been used also in numerous clinics throughout the country, apparently without difficulty. It can be recommended absolutely. Further discussion seems needless with regard to it, excepting as to its reaction upon various suture materials commonly in use at the present time. It has been suggested by members of this association that study of its effect upon plain and chromic catgut, nylon, and silk might be of value. Such experiments have, therefore, been undertaken and are reported here.

EXPERIMENT 1

This experiment naturally falls into two

TABLE 1-A

ABILITY OF SOLUTION NO. 4 TO STERILIZE VARIOUS SUTURE MATERIALS

Suture Material	Time in Solution No. 4					
	½ min.	1 min.	2 min.	3 min.	4 min.	5 min.
1. 3–0 plain gut Ethicon code 753	2	0	0	0	0	0
2. 3–0 chromic gut Mild type B Davis & Geck Prod. 1668	3	0	0	0	0	0
3. 5–0 plain gut Boilable Davis & Geck Prod. 1663	2	2	1	0	0	0
4. 5–0 dermalon Processed nylon Davis & Geck Prod. 1682	1	0	0	0	0	0
5. 6–0 silk Black braided Davis & Geck Pro. 1632	4	4	3	1	0	0

TABLE 1-B

EFFECT OF STERILIZATION ON TENSILE OR BREAKING STRENGTH

Suture Material	Breaking Tension in Grams	
	Before Immersion in Solution No. 4	After 10 Minutes' Immersion in Solution No. 4
1. Anacap silk 6–0	200	175
Black braided	200	190
Davis & Geck	175	200
Prod. 1632		
Average	190	188
2. Plastic suture Dermalon 5–0	575	575
Processed from nylon	575	575
Davis & Geck	600	700
Prod. 1682		
Average	583	616
Same material but no	800	775
middle knot	700	725
Average	750	750
3. 000 plain cut	1,250	1,200
Ethicon code		
753	1,300	1,100
	1,300	1,225
Average	1,280	1,175
Second sample		
Using 6 inch strands	1,175	1,200
4. 000 mild type B	1,200	1,450
Chromic gut		
Davis & Geck	1,125	1,300
Prod. 1668		
	1,275	1,600
Average	1,200	1,450
Second sample		
Using 6 inch strands	1,450	1,475

parts: (a) The ability of the solution to sterilize the various suture materials, and (b) the effect of sterilization upon the tensile, or breaking strength, of the substances exposed to its action. Table 1-A will deal with the first of these, while Table 1-B will report the results of the second.

The first procedure concerning the ability of the solution to sterilize suture material was carried out as follows:

A heavy suspension of bacillus subtilis in tryptose broth was prepared. This suspension, containing a mixture of cells and spores, showed 48,000,000 organisms at time of use, to each ml.

The indicated suture material was cut into one-inch lengths and immersed with gentle shaking in the bacterial suspension for five minutes, at the end of which the sutures were removed from the suspension and placed in solution No. 4, where each remained for the length of time indicated in Table 1-A. At the intervals shown, one piece of suture was removed from the solution and placed in a sterile petri dish. Molten agar was poured into the dish and mixed gently, allowed to harden, and then incubated for 24 hours at 37°C. Where no growth was seen at 24 hours, a further incubation of another 24 hours was allowed.

The number of colonies found after each exposure is indicated by the digit appearing in each column in Table 2.

The second part of the experiment, dealing with tensile strength, was conducted as follows:

The sutures, as indicated in Table 1-B, were divided into two equal portions. One portion was used for testing before exposure to the action of solution No. 4, while the second portion was reserved for testing after an exposure of 10 minutes to the solution. Thus, as nearly identical material as possible was used in both instances. The method for determination of the breaking point was also identical.

TABLE 2

EFFECT OF IRRADIATION ON COLONY GROWTH

Time in Minutes	Irradiated by U.V. Lamps (2537 A.) G-15, T-8		Nonirradiated	
	Instruments	Agar Plates	Instruments	Agar Plates
0	280	2600	317	3,250
1	....*	1000	390	3,700
2	170	80	285	3,000
4	80	35	260	2,470
6	33	30	....*	3,250
8	10	21	300	3,100
10	4	14	330	3,380
15	1	11	310	3,900
20	0	1	280	2,990
25	0	0	340	3,500
30	0	0	295	3,900

* Overgrowth; no count made.

Two brass clamps were made, having smooth jaws with a channel, to hold knots tied in the sutures, cut in behind the jaws. Pressure was applied to the jaws by means of a thumb-screw. A hole in the far end of the clamp allowed suspension from the hook of a simple spring balance, and provided a grip for applying increased pressure on the opposite clamp member. A simple knot was tied near the end of a piece of the suture material, a second single, simple knot was tied in the suture about one inch from the first, and a third knot tied about one inch beyond the second.

This procedure was followed in all instances, excepting in two experiments on Dermalon 5-0, processed from nylon, where the middle knot was omitted, as indicated in Table 1-B.

The end knot was placed in the clamp channel and pressure applied to the suture between the jaws by tightening up on the screw, using finger pressure only. The third knot was placed in the same manner in the second clamp. This left the second knot about midway between the two clamps. One clamp was placed on the hook of the balance and force was applied to the other clamp in a slow, steady fashion until the suture broke; the force always exerted in a direction vertical to the axis of the balance. The breaking pressure was read from the scale of the balance.

Several trials were made of each sample and averaged, as shown. In two cases, the breaking samples were six or seven inches long, to rule out erratic results due to accidental weak spots in the material.

The other half of each sample was immersed in solution No. 4 for 10 minutes, and the above procedure repeated.

An attempt was made to keep the sutures moist at all times.

It was not found practical to include the relation of the knots to the breaking point, in the table; sufficient to say that the knots had no relation to this point in any of the materials used, except nylon. With nylon, the break invariably occurred at the knot, both before and after exposure to solution No. 4.

The first part of this experiment showed silk sutures to be the most difficult to sterilize, doubtless due to their complex nature, but that even in these, sterilization was complete in four minutes' time. Nylon sutures, with the hardest surface, were sterilized in the least time, one minute. The second part of the experiment demonstrates that in the case of none of the materials used was the tensile strength lessened by 10 minutes' immersion in solution No. 4.

While, from the foregoing findings, it will be seen that a satisfactory method of sterilizing instruments and sutures without interfering with their surgical effectiveness has been found, it has also developed that a very high degree of contamination occurred in our clinic between the time of the removal from the sterilizing solution and the use of the instruments in operation.

It has been demonstrated that the major part of this type of contamination takes place through the medium of dust-borne organisms settling in the water bath in which the germicidal solution is washed from the instruments, upon the towels for drying them, or directly upon the instruments themselves, as they lie spread out upon the table before and during operation.

It has been suggested, therefore, that benzolkonium chloride (zephiran chloride) 1/3,000 be substituted for the water bath, that towels for drying instruments be protected from dust, and that those instruments which are to be inserted through the sclera or cornea into the eyeball be dipped into some type of sterilizing solution immediately before use.

For this purpose, boiling water, which has long been in use, was investigated and found to reduce the contamination from an average of 36.22 percent to 14.28 percent, and that an aqueous solution of zephiran chloride 1/3,000, after immersion for two and one-half seconds, would reduce this percentage to 6.66 percent.

Neither of these methods is entirely satisfactory. It is difficult to prevent the evaporation of boiling water, and the humidity of the atmosphere of the operating room is definitely increased thereby. Zephiran is not entirely innocuous. Experiments have shown that the injection into the anterior chamber of rabbits of 1/3,000 solution results in nebulous opacites of the corneal endothelium, which, however, tend to clear up in from three to five weeks, and that an atrophy of the iris, most marked in the immediate neighborhood of the site of the injection, appears in from two to three weeks, and persists indefinitely.

Even though such experiments greatly exaggerate the situation occurring in actual operative practice, yet it seems that it would be advantageous if some method entirely free from such disturbances could be substituted for the use of zephiran. It is now proposed to describe such a method, which has been found very highly satisfactory and which has none of the disadvantages of those formerly suggested.

Ultraviolet lamps of 2,537 Angström units have been developed extensively and are in use commercially on a rather comprehensive scale in canneries, bottling works, Army barracks, and a few operating rooms, to prevent contamination. Such sterilization is usually directed toward the entire chamber involved, in which case the rays of the lamp are thrown against the ceiling, and from there reflected over the entire room.

To mention one instance of the use of such lamps in the operating room, at the Department of Surgery of Duke University Medical School and Hospital, Dr. Deryl Hart has used with notably fine results the direct rays from the lamps upon the field of operation, protecting the surgeons, nurses, and patient, other than the immediate field of operation, by suitable gowns and dressings. This is obviously impossible in the case of eye surgery, due to the fact that the eye being operated upon would be injured by such direct exposure. There is little objection, however, to subjecting the instruments, as they lie upon the Mayo table immediately before and during operation, to the rays from such germicidal lamps.

The problem as to whether such exposure would prevent infection from dust-borne organisms has presented a most interesting field of investigation. In all the following experiments, two General Electric germicidal lamps, known as G-15, T-8, have been used. Similar lamps, however, are made by a number of other manufacturers.

These same lamps have been used by me in operations involving intraocular procedures since early October, 1951. They are mounted in the usual manner under a metallic hood, suspended by a floor stand, which can easily be moved about the room.* As soon as the instruments are laid upon the Mayo table, the lamps are placed immediately above them at a distance of 12 inches from the center of the table.

In an effort to determine accurately the effectiveness of such exposure, a number of experiments have been performed, with the assistance of Mr. William Moor.

Experiment 2

In this experiment, two sets of hemostats were sterilized by laying them out in pans wrapped in paper to prevent accidental contamination, and the whole placed in the autoclave at 15 pounds pressure for 15 minutes. The autoclave was used for this purpose, rather than sterilizing solution No. 4, for convenience sake only. The instruments involved were old hemostats, the preservation of which was not a matter of any consequence. At the same time, two sets of petri dishes, containing sterile tryptose-dextrose agar, were also prepared.

One set of instruments and one set of dishes were placed under the sterile lamps at 12 inches' distance. The other set of instruments and dishes were grouped near by,

* Brackets to carry germicidal lamps are made by the Dazor Manufacturing Corporation, 4481-87 Duncan Avenue, Saint Louis, Missouri.

but protected from the rays of the lamps by corrugated cardboard. Both the sets of instruments and opened dishes were then exposed to the spray from an atomizer loaded with a 24-hour culture of bacillus subtilis containing ± 40,000 bacteria per ml.

At intervals, as noted below, one instrument from each group was removed by sterile forceps and placed in a sterile flask containing 100 ml. of sterile tryptose-dextrose broth. The broth was then shaken over the instrument for complete contact, after which 10 ml. of this broth was removed to a sterile plate and mixed with sterile molten agar. After the mixture had been allowed to solidify, the whole was incubated at 37°C. for 24 hours. The colonies on each dish were then counted, as shown in Table 2.

As each instrument was removed, one petri dish from each group was covered, removed to the incubator, and incubated for 24 hours at 37°C., after which the colonies on each plate were counted, as here recorded.

Experiment 3

A third experiment was carried out in a similar manner. Rabbit blood tryptose-dextrose agar plates were used instead of plain agar. The amount of broth was reduced to 50 ml. instead of 100 ml., and two plates were poured from each sample, one containing 1.0 ml. of wash broth, and the other 5.0 ml. The bacillus subtilis suspension contained ± 30,000 organisms per ml.

It will be seen (table 3) from these experiments that instruments and agar plates highly contaminated with bacillus subtilis were rendered entirely sterile, the one in 20 minutes, the other in 25 minutes, and that the amount of contamination remaining even after 10 minutes was practically negligible.

On the other hand, nonirradiated instruments and plates highly contaminated at the beginning changed very little in bacterial count throughout the experiment. It is of great interest that the instruments used for these experiments were all hinged, and many of them not in first-class condition, permitting bacteria to lurk in many crevices inaccessible to direct rays from the sterilizing lamps.

In both the foregoing experiments, it is obvious that the amount of contamination was far greater than that which could possibly be encountered under even the worst operating-room conditions. A further experiment was, therefore, undertaken to determine just what might be expected under normal surgical procedures, both as to the number and destruction of organisms met, and also to determine roughly the types of organisms likely to be present in contamination due to dust.

Experiment 4

Two trays of hemostats, simulating the normal array of instruments as used in ophthalmic operations, were wrapped in

TABLE 3

Effect of irradiation by germicidal lamps

Time in Minutes	Irradiated by U.V. Lamps (2537 A.) G-15, T-8			Nonirradiated		
	Instruments		Agar Plates	Instruments		Agar Plates
	1 ml. 1 ml.	5 ml. 5 ml.		1 ml. 1 ml.	5 ml. 5 ml.	
0	X	X	700	X	X	1,050
5	2	4	4	—*	—*	800
10	2	17	0	3	9	630
15	0	0	0	2	13	800
20	0	0	0	5	52	750
25	0	0	0	6	28	900
30	0	0	0	3	12	700

X = Not done.
* Overgrowth; no count made.

TABLE 4

COLONY COUNT DEMONSTRATING EFFECT OF IRRADIATION

Time in Minutes	Irradiated by U.V. Lamps, G-15, T-8			Nonirradiated		
	Blood Agar Plates	5 ml. Broth Washings	4.8 ml. Broth Washings	Blood Agar Plates	5 ml. Broth Washings	4.8 ml. Broth Washings
10	0	280*	85*	5*	2*	240*
20	0	30*	20*	9	0	1
30	0	1	0	13	3	1
40	0	0	0	34	5	3
50	0	0	2	28	8	3
60	0	0	0	26	14	13
70	0	X	X	32	X	X

X = Not done.

* Organisms were about evenly divided between bacillus subtilis and a nonhemolytic staphylococcus albus.

Other organisms seen were: two colonies of a protus vulgaris, 3 molds, 1 penicilium, 1 mucor and 1 hormodendrum; eight colonies of hemolytic strains of staphylococci; 11 colonies of streptococci (2 hemolytic); two colonies of megatherium; several other types not identified.

paper and sterilized in the autoclave at 20 pounds for 30 minutes. These sterile trays, upon removal from the autoclave, were then placed on Mayo tables. At the same time, and on the same tables, a series of rabbit blood tryptose-dextrose agar petri plates were exposed. One table was arranged under the germicidal lamps in such a manner that the center of the table was 12 inches from the center of the lamps. The other table, while close to the former, was placed in such a manner that instruments and plates lying upon it were protected from irradiation.

At the times indicated in the table, one blood agar plate of each group was covered and removed. One hemostat from each tray was removed and placed in a sterile petri plate, and washed by blowing 10 ml. of tryptose-dextrose broth over it three times, using a sterile pipette. This broth was recovered and divided into two sterile petri plates and sterile two-percent tryptose-dextrose agar immediately poured over it, mixed, and allowed to solidify.

All petri plates from both groups were then incubated at 37°C. for 24 hours and colony counts made (table 4).

Rough identification of some of the colonies also was made, but type distributions were not attempted.

It should be noted that just after the instruments had been laid out and the plates exposed, a group of anesthetists wearing ordinary uniforms did considerable walking back and forth very close to the tables, probably being responsible for the exceptionally high initial counts.

Once again, the effectiveness of the irradiation by germicidal lamps is clearly demonstrated.

Several infections occurring in our clinic recently have been traced to solutions of pilocarpine two percent in 1/5,000 zephiran, contaminated by proteus vulgaris, and atropine one percent in 1/20,000 bichloride, contaminated by bacillus subtilis, instilled at the close of operation.

EXPERIMENT 5

Experiment 5 was undertaken in an effort to determine whether or not these solutions also could be sterilized by the germicidal lamps, and if so, how much time such sterilization would require. Tables 5 and 6 show that the pilocarpine solution was rendered completely sterile in five minutes, and the atropine in 10 minutes.

The contaminated solutions were divided into two portions each and placed in standard medicine glasses that had been sterilized in the autoclave (15 pounds, 30 minutes). One group was placed under the germicidal lamps, G-15, T-8, with the lamps 12 inches above the solutions; the other group was protected

TABLE 5

EFFECT OF GERMICIDAL IRRADIATION ON PILOCARPINE AND ATROPINE SOLUTIONS

Time in Minutes	Irradiated by U.V. Lamps, (2,537 A.) G-15, T-8			Nonirradiated	
	Quantity in ml.	Pilocarpine Colonies	Atropine Colonies	Pilocarpine Colonies	Atropine Colonies
0	0.001	29	2		
	0.01	640	16	960	3
	0.01	600	18		
	0.10	5,600	78	8,800	27
0.5	0.01	280	2		
	0.10	1,840	14		
2.25	0.01	18	1		
	0.10	56	4		
3.25	0.01	14	0		
	0.10	78	2		
4.5	0.01	9	0	1,120	2
	0.10	50	1	—*	11
6.5	0.01	5	0		
	0.10	21	2		
7.0	0.01	2	0		
	0.10	13	0		
9.0	0.01	1	0		
	0.10	10	0		
10.0	0.01	0	0	890	2
	0.10	0	0	1,200	13
11.0	0.10	0	0		

* Overgrowth; no count made.
Note: All fluids irradiated adjusted to one inch at start of experiment; nonirradiated at one-fourth inch.

by space from the effect of the ultraviolet radiation. At the indicated times, the indicated quantities of each solution were removed and placed in sterile petri plates, and molten agar poured in and mixed. The agar was allowed to harden and incubated 24 hours at 37°C., then the colonies were counted, as shown.

From this experiment, it is evident that such contaminated solutions can be sterilized with ease in periods of 10 minutes by exposure to these lamps. It is recommended in all cases where the sterility of the solutions to be used at the close of operation is at all doubtful, that such a procedure can, and should be, resorted to.

The routine sterilization procedure since the development of solution No. 4, previously described, in the ophthalmic operating rooms in McMillan Hospital, has been to place the sterile instruments, for the removal of this solution, in a bath of aqueous zephiran

TABLE 6

COMPARISON OF IRRADIATED AND NONIRRADIATED STERILE WATER BATHS

Time in Minutes	Irradiated by U.V. Lamps (2,537 A.) G-15, T-8 Sterile Water Bath		Nonirradiated Sterile Water Bath	
	Quantity in ml.	Colonies	Quantity in ml.	Colonies
0			5	1*
5	5	0	5	3
13	5	0	5	7
	2	0	2	2
25	2	0	2	3
35	2	0	2	4
45	2	0	2	6
60	2	0	2	9

* One surface colony of a mucor.

1/3,000. The use of zephiran instead of sterile water was necessitated inasmuch as it was found that the sterile water exposed to the air of the operating room rapidly became contaminated by dust-borne organisms. Much complaint has arisen from the nurses carrying out this procedure concerning the rapid clouding of the zephiran so used, and the slippery condition of the instruments upon removal for it. To solve this difficulty, a sixth experiment was undertaken, exposing six inch petri dishes containing sterile water to radiation from the germicidal lamps. The protocol shows the effect of such exposure upon these plates.

These observations demonstrate that the sterile water bath may be kept sterile and, therefore, substituted for the objectionable zephiran, if protected by germicidal lamps.

Conclusions

1. From the foregoing studies, it is evident that the sterilizing solution developed by the author, and now in use in numerous clinics for a number of years, answers the primary requisites of such a solution in that, in a brief period, five minutes, it effectively sterilizes all types of metallic surgical instruments without damage, and that, furthermore, it may even be used as a preservative for such instruments.

2. The various suture materials in common use may be sterilized without alteration of their efficiency by exposure to the same solution for a period of five minutes.

3. Sterilization of the instruments of all types used in ophthalmic surgery may be maintained for an indefinite time by exposure to ultraviolet lamps (2,537 A.) at the recommended strength and distance.

4. Sterile instruments, contaminated while spread upon a sterile table by dust-borne organisms, may be restored to sterility in approximately 20 minutes by exposure to the lamps, as suggested.

5. Atropine, one-percent solution in bichloride 1/20,000, and pilocarpine, two-percent solution in zephiran 1/5,000, contaminated by bacillus subtilis and proteus vulgaris, the usual invaders, can be sterilized in from seven to 10 minutes, respectively.

6. Sterile water, exposed in shallow dishes, may be kept sterile for an indefinite period, when irradiated as in the foregoing experiments; and sterile water, so treated, is a safe medium for the removal of chemical sterilizing solutions, whereas sterile water exposed in a similar manner, without irradiation, rapidly becomes contaminated, largely destroying the effect of the sterilizing solution.

It appears to be demonstrated, therefore, that the preceding simple method for the prevention of infection in ophthalmic surgery from contaminated instruments is a safe procedure, free from complications.

I believe strongly that the vast majority of ophthalmic surgeons are either unaware of the foregoing facts, or are more or less indifferent to them, and that they are prone to leave the details of the preoperative preparations to the tender mercies of the operating-room staff. I deem it, therefore, highly worth while to call attention to these facts once again, and to delineate these details of modern methods of procedure.

Finally, I wish once again to acknowledge the invaluable assistance of Mr. William Moor in the conduct of the experiments herein reported.

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SYMPATHETIC OPHTHALMIA*

The history of its pathogenic studies

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Historical survey

Sympathetic ophthalmia is one of the oldest known diseases of man, since its existence was apparently recognized nearly 1,000 years ago.[1] Bartisch,[2] in 1583, seems to have been the first to perceive that an internal disease of one eye might follow an injury to its fellow. However, the significance of this observation obviously was not realized, for, with the exception of brief comments by Bartholinus[3] and Bidloo,[3] the literature on the subject was quite barren for nearly two centuries.

In 1741, LeDran[3] showed his recognition of the disease and a surprising insight on how it might be brought about. He warned that one should not wait for pus to form in severe ocular inflammation since sight may be lost by the inflammation communicating itself to the good eye along the length of the optic nerve.

LeDran's pertinent observations evidently had little or no effect in stimulating interest in sympathetic inflammation, for the subject seems to have been largely ignored for the next 60 years. However, with the advent of the 19th century, there was an increasing interest in the disease and a more general recognition of it.

During this period, outstanding articles were contributed by Beer[3] (1802), Demours[3] (1818), Wardrop[4] (1818), Lawrence[4] (1833), and Von Ammon[3] (1835). In most of these, chief consideration was given the danger of involvement of the sound eye after injury to its fellow.

MacKenzie's theory

These articles, together with others of lesser importance, served as a prelude to the epoch-making delineation by MacKenzie,[4] in 1840, in which for the first time the condition was recognized as a disease entity which he termed sympathetic ophthalmia. In this and subsequent contributions, he fully and accurately described the characteristics of the condition, and reached many conclusions which have stood the test of time and are generally accepted to this day.

He conceived sympathetic ophthalmia to be a binocular disease caused by ocular trauma. He pointed out that there was a greater likelihood of its occurrence after penetrating wounds, particularly those in the ciliary region with iris prolapse. He noted that the involvement in the second eye, which followed five to six weeks later, was more severe and offered a less favorable outcome than that in the injured eye.

MacKenzie believed that the seat of the trouble in the injured eye was an inflammation of the retina which "propagated" to the retina of the second eye by way of the optic nerves and chiasm. However, he considered it not impossible that the blood stream and ciliary nerves might be a "source of spreading inflammation." He recognized the gradual involvement of all the intraocular structures, but laid particular emphasis on the changes occurring in the iris, lens, and vitreous.

MacKenzie's theory of transmission of the inflammation by way of the optic-nerve pathway was so simple and obvious that at first it found general acceptance. Nevertheless, it was not long before objections began to appear. It was argued that to meet the precepts of this theory the inflammation in the sympathizing eye would always have to begin as a papillitis, and not as an iridocyclitis as was usually the case.

Largely because of this discrepancy, Mac-

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Kenzie's hypothesis was gradually abandoned and the ciliary nerves became suspect. This was based on a new idea that reflex action could incite genuine inflammation and, since the ciliary nerves supply the uvea, it was presumed that their irritation could account for the resultant inflammation.

Mueller's theory

Although this theory had been suggested earlier, Heinrich Mueller,[5] in 1858, first gave it widespread recognition. He speculated that the inflammation in the injured eye produced a functional irritation of the sensitive ciliary nerve fibers, and that this influence was transmitted to the second eye by reflex action.

According to Mueller's reasoning, the process could not be transmitted by the optic nerve, for it was usually found to be atrophied. Moreover, it seemed to him more reasonable to suspect the ciliary nerves because of their anterior situation and consequent greater exposure to irritation. This, together with the general predominance of anterior inflammation of the two eyes in sympathetic ophthalmia, formed the basis for his contention.

Mueller's explanation was readily accepted and was enthusiastically upheld for about 20 years. However, with the development of bacteriologic knowledge it was gradually discarded, and remained a vague and almost forgotten unscientific idea for many years.

Recent theories

Then, in 1935, Arkhangelskiy[6] revived the old hypothesis, and brought it up to date according to modern physiologic concepts of the regulation of the tissue metabolism of the nervous system. He viewed the disease as a neurotrophic uveal disturbance caused by prolonged low-grade inflammation of the peripheral endings of the ciliary nerves of the injured eye. He expressed the belief that early enucleation of the exciting eye eliminates the chronic irritation of the ciliary nerve endings, and that the surgical trauma causes new functional readjustments in the nervous system which lead to interruption of the processes in the second eye.

In a recent stimulating and comprehensive article by Naquin,[7] the theory has been thoroughly reviewed and reëvaluated. He has asked for a reëxamination of our thoughts regarding the pathogenesis of sympathetic ophthalmia, and has advocated the rejection of the ideas of infection and allergy in favor of consideration of the neurogenic theory.

Naquin has based his thesis on the still somewhat controversial question of the presence of trophic nerves, and on the symmetrical participation of the nervous system in pathologic processes, assuming that if one paired organ is attacked there is a greater tendency for the opposite one to become affected.

Citing other examples of symmetrical lesions of the body following unilateral nerve trauma, he proposed that the occurrence of sympathetic ophthalmia be explained in a similar manner. He considered it significant that the disease most frequently follows perforating wounds involving the iris and ciliary body, both of which are richly supplied with nerve fibers. He maintained that the neurogenic theory explains not only the reason for the favorable effect of early enucleation, but also the occurrence of sympathetic opthalmia in association with malignant melanoma of the choroid through chronic irritation of the ciliary nerves. Moreover, he suggested that participation of the nerve pathways might account for the occasional extraocular lesions of the skin, hair, and ears.

Theories of infection

The idea that microörganisms might cause disease was very old, but until 1840 it was only hypothetical. At that time Jacob Henle terminated its speculative aspects by outlining with great accuracy the germ theory and the type of experiments which would be necessary to verify his postulates.[8]

During the next 30 years, little was accomplished to demonstrate the feasibility of this theory, but early in the 1870s various pathologists observed through the microscope extraneous bodies in pathologic tissues. The enthusiasm generated by the identification of these bodies as bacteria caused a tremendous renaissance of the germ theory of disease. It passed completely from the theoretical to the factual when subsequent experimental and clinical investigations demonstrated the relation of microörganisms to many systemic disturbances.

By 1880, the principle had become so widely accepted that its application to sympathetic opthalmia came as a matter of course. The idea of it being an infectious process seemed then, as it does now, an attractive and logical notion.

Such was the theory proposed by Berlin,[2] who, in 1880, was first to suggest that sympathetic ophthalmia was caused by infectious microörganisms which entered the general circulation from the injured eye and later attacked the fellow eye without affecting the rest of the body. He explained the immunity of other body structures by assuming the presence of conditions in the second eye which favored the development of the organisms.

A year later both Leber[3] and Snellen[9] expressed their agreement with Berlin regarding the infectious nature of the disease, but maintained that it was transmitted to the second eye by way of the optic pathways. Snellen, who assumed the organisms to be peculiarly adapted to choroidal tissue, suspected the lymph channels of the nerve, while Leber favored transmission along the nerve fibers.

The publication of Leber's and Snellen's articles increased interest in the returning popularity of the theory of optic-nerve transmission. The pendulum had begun to swing back to this theory in the late 1870s, apparently initiated by Alt's[10] (1877) discovery of inflammatory changes in the optic-nerve stump of a number of enucleated exciting eyes. It received further impetus by the confirming pathologic studies of MacGillvary[4] and of Horner and Knies.[8] The latter investigators offered additional evidence of optic nerve transmission when they found that colored fluid injected into the subarachnoid space of one nerve forced its way through the chiasm into the other optic nerve sheath.

Deutschmann's animal experiments

So far, beginning with Maats's[3] unsuccessful investigations in 1869, few animal experimentations had been attempted, and these had given uniformly negative results. Hence, when Deutschmann[5] (1889) reported that he had successfully produced sympathetic ophthalmia in rabbits and had proved that it was transmitted by way of the optic nerve and its sheaths and the chiasm, it appeared that the pathogenesis had been solved. His conclusions received widespread recognition, and although they were later discredited by the inability of others to confirm his results, the influence of his concepts persisted for many years.

The crux of Deutschmann's conclusions was his contention that the eyes and optic-nerve pathways of rabbits resembled those of man both anatomically and in their reaction to inflammation.* He based his convic-

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Animal experiments

* In evaluating animal experiments, the biologic and immunologic differences between animals and man must be remembered. As a rule, each kind of animal has its own peculiarities of diseases, and it is impossible to create some diseases in some animals. The almost uniform failure of various investigators to produce sympathetic ophthalmia experimentally indicates that the lower animals are not subject to it. Hence, Deutschmann's successful reports are difficult to explain.

His assertion, however, that one positive result proves more than many negative ones may be the answer. For it is possible that he placed undue emphasis on a minority of apparently successful results which were really caused by some extraneous factors.

Randolph warned that too much stress must not be placed upon an outcome which accords with the theory of the experimenter unless confirmed by 80 percent of the results.

One pitfall in animal experimentation is failure

tion on chemical and bacteriologic investigations.

In his early experiments he reported that the injection into the vitreous of the spores of aspergillus, and in other cases croton oil, produced "sympathetic" changes in the fellow eye. These changes, which he believed to be chemical in nature, extended along the optic nerve and sheaths of the inoculated eye to the chiasm, spreading over the pia mater and the base of the brain, and thence extended into the optic nerve of the fellow eye.

In attempting to prove that microörganisms would follow the same route and thus produce sympathetic inflammation, he injected cultures of Staphylococcus aureus and Staphylococcus albus in a similar manner.

In these animals, although papillitis could be observed in the second eye five to 21 days later, there was no evidence of anterior uveal involvement. However, since all of the rabbits had died of systemic infection soon after the appearance of the optic disc changes, he assumed that iridocyclitis would have occurred had they lived long enough.

In order to shorten the duration of the experiment he injected Staphylococcus aureus directly into the cut end of the optic nerve. This was followed by purulent inflammation of the iris and ciliary region of the second eye. Hence, he concluded that the microorganisms had produced sympathetic ophthalmia by following the route indicated by his previous experiments, for similar inflammatory changes were found throughout the structures of the optic-nerve pathways. He presumed that the organisms passed from the optic disc of the second eye through the choroid into the iris in some cases, and in others, that they passed rapidly forward through the vitreous to the zonule, and thence to the iris and ciliary body.

During the next few years, Deutschmann's experiments were repeated by many investigators who, with the exception of Alt,[11] reported quite generally negative results (H. Gifford,[12] Mazza,[13] Randolph,[3] Limbourg and Levy,[4] Schirmer,[14] Greef,[5] Ulrich[8]).

It is true that, occasionally, inflammatory changes, and even microörganisms, were found in the second eye. However, in these cases the infection appeared to have been blood borne, since other body organs were also affected.

There were other factors which tended to discredit Deutschmann's bacterial migration theory. One was the pattern of infiltration of the optic nerve of the sympathizing eye. In the few instances in which it was examined microscopically, the changes, rather than being more marked posteriorly as one would expect, appeared to diminish the farther back the nerve was examined.[15]

Another factor was the clinical observation that severance of the optic nerve sometimes failed to prevent sympathetic ophthalmia.[3] Other arguments used against the theory were the failure of panophthalmitis to cause the disease and the inability to obtain positive cultures from resected sections of the optic nerve from cases of sympathetic ophthalmia.[15]

In spite of the failure to confirm Deutschmann's results and the many criticisms which followed, the germ theory of disease was so attractive that the negative findings had little dampening effect on the idea that sympathetic ophthalmia was an infectious process. Nevertheless, there remained the question of the nature of the organism causing the disease, and serious doubt had arisen as to the path by which it reached the second eye.

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to know the normal histologic structure of animals' eyes. Randolph made this mistake in assuming that the rich distribution of nuclei in the normal optic nerve of dogs was inflammatory infiltration showing the route by which sympathetic ophthalmia traversed from one eye to the other.

Samuels has pointed out the dissimilarity of the rabbit and human choroid. In rabbits, apparently, it is constitutionally more resistant and the circulation more active in carrying away toxins. As a result, irritative lesions cause lymphocytes to appear, but pus cells are notable for their absence.

It is not difficult to make a mistaken diagnosis of sympathetic ophthalmia in rabbits, due to the fact that groups of capillaries and endothelial buds in the dense lymphocytic infiltrations may simulate epithelioid cells.

Route of transference

Attempts to discover the route of transference seem to have been particularly intriguing and all sorts of theories were proposed. The propinquity of the two eyes suggested some mode of direct transmission by way of the nose-bridge lymphatics as submitted by Scheffels,[4] or by way of venous communications as advocated by Arnold,[4] Gilbert,[16] and Motais.[17]

A practical basis for such theories was brought out by H. Gifford, in 1886, while attempting to confirm Deutschmann's results. Utilizing anthrax bacillus in rabbits, he found the optic nerves and sheaths unaffected. On the other hand, he did find definite evidence that the bacilli were carried by the lymph stream from the vitreous of the inoculated eye by way of the optic nerve and its vessels through the orbit into the cranial cavity, and thence through the subvaginal space to the suprachoroidal space of the fellow eye.

Metastatic bacterial invasion

Although the Deutschmann hypothesis of bacterial migration seemed untenable to most investigators, it maintained some degree of popularity until shortly after the turn of the present century. But it waned rapidly after Roemer[15] (1903) advanced the idea of metastatic bacterial invasion.

It was Roemer's contention that during the inflammation which follows injury, some of the organisms enter the blood stream and by some peculiar power of selection attack the sympathizing eye. He believed that the invasion occurred early, but that the organisms may remain dormant for weeks before creating an inflammatory reaction. Thus, he attempted to explain those cases of sympathetic ophthalmia which, on occasion, do not set in until some time after prophylactic enucleation.

Schmidt-Rimpler theory

Shortly after Deutschmann had proposed his bacterial migration hypothesis Meyer[1] (1891) suggested that ciliary-nerve reflex induced sympathetic irritation in the second eye if it was normal, and sympathetic ophthalmia if it contained microörganisms.

One year later Schmidt-Rimpler[18] introduced the combined ciliary nerve-germ theory. He assumed that the traumatic inflammation in the first eye caused impulses to pass through the ciliary nerves which created a vasomotor and metabolic disturbance in the uvea of the sympathizing eye, thus offering a favorable site for the lodging of organisms circulating in the blood.

This theory received some support through experiments tending to show that sympathetic irritation favored the passage of organisms from the blood stream into the tissues of the eye.[4] It received additional support because it was compatible with certain clinical aspects of sympathetic ophthalmia such as the initial involvement of the anterior segment and the failure of sectioning of the optic nerve to prevent its onset.

On the other hand, there were many objections to the idea. The most serious criticism concerned the frequent absence of sympathetic irritation in the disease, for its occurrence was the cornerstone of the hypothesis.

H. Gifford,[4] who was intrigued by the Schmidt-Rimpler theory, considered it untenable. His chief concern seems to have been why any unspecified organism already in the blood should attack the second eye only after a penetrating wound, whereas, according to this theory, it might follow numerous other causes of reflex irritation. However, he admitted that possibly the reflex disturbance of the circulation in the second eye might influence the location of the causative organism or reinforce its action.

In Gifford's opinion, to make the theory at all valid, one must suppose the organism to have had an original or acquired special affinity for the uveal tract.

Similar ideas were expressed by O'Connor[19] and Meller.[20] Roemer also objected to

the Schmidt-Rimpler theory, contending that sympathetic ophthalmia must be caused by a specific organism through a blood current metastasis, uninfluenced by the ciliary nerves.

The proposal that the organisms were already in the blood stream before injury was unacceptable to many investigators because it seemed to them more plausible that entrance into the eye occurred with the injury. However, others besides the Schmidt-Rimpler school accepted the nonocular approach.

An outstanding example was Meller,[21] who proposed that the organisms entered the blood stream through a skin lesion or some nonocular mucous membrane, and that they developed in the wounded eye because of disturbed nutrition. He assumed that, as the result of this development, they acquired an increased power of attacking healthy eye tissue, and then re-entered the blood stream and attacked both eyes.

This rather complicated hypothesis was offered as an explanation for the occurrence of sympathetic ophthalmia in the absence of a perforating injury, such as in choroidal tumors and subconjunctival rupture of the sclera.

Toxic products

Although the idea of bacterial infection seemed to offer a particularly acceptable explanation for the occurrence of the disease, there were many points of disagreement even among its most enthusiastic advocates. Not only was there a difference of opinion regarding the source, route taken, and mode of action of the organisms, but also as to whether or not the bacteria themselves were transmitted to the second eye.

There had been quite universal failure in demonstrating their presence, hence some investigators maintained that only the toxins of the bacteria entered this eye. It was assumed that toxic products of bacterial origin passed directly by way of the optic nerves and chiasm,[4] or that they were transmitted by the lymph or blood stream.

Eversbusch and von Rothmund,[2] who, in 1882, proposed the latter route, suggested alternative ideas involving damage to the vasomotor ganglia or reflex action in the second eye.

It was generally believed that the reaction in the sympathizing eye was microbic or toxic in character. However, Guillery[4] maintained that it consisted of an autointoxication caused by the action of ferments.

Presence of suppuration

In most of the early animal experimentation pus-producing organisms were utilized in attempting to create sympathetic ophthalmia. The failure of these experiments can be attributed to the immunity of animals to the disease. Regardless of this, the employment of such organisms was futile, because one of the first useful things known about sympathetic ophthalmia was its rare occurrence in the presence of suppuration. In fact, early in the 19th century, long before the germ theory of disease was accepted, suppuration was sometimes purposely induced in injured eyes as a prophylactic measure. This practice had its origin in the treatment of bilateral ophthalmia in horses, which in many respects is similar to sympathetic ophthalmia.[4]

For a great many years, there was considerable speculation and some research in efforts to explain the action of suppuration in these cases. It was assumed by Leber and Deutschmann that it destroyed the offending organism and, in addition, that it caused expulsion of the infectious contents of the globe by its rupture.

H. Gifford disagreed with this explanation, contending that blockage of the lymph spaces offered a mechanical obstacle to the migration of the organisms.

Schirmer, while supporting the idea of destruction of the offending organisms by the pus germs, contended that in most cases of panophthalmitis the specific organism of sympathetic ophthalmia was never present.

The extensive destruction of the uveal tissue found in pathologic specimens of

suppurative infection has caused a modification of the early ideas regarding the role of the pus organisms. It is now believed that their ability to destroy uveal tissue, as well as the hypothetic agent, accounts for the infrequent outbreak of sympathetic ophthalmia in the presence of septic infection, and that, when it does occur, the destruction has not been complete.[27]

Barton of Manchester, England, in the early 19th century seems to have been the first to induce purulent infection in humans to prevent sympathetic ophthalmia. It was his practice to remove a large corneal flap and then poultice the eye.

How widespread this procedure became is not clear, but until 1851 when Pritchard[1] first advocated removal of the eye it was the only practical method of prophylaxis. Pritchard apparently introduced the procedure as a therapeutic measure, and it was not until 12 years later that its true value was realized. For in 1863, Critchett[8] demonstrated that enucleation was ineffective once the inflammation had appeared. Thus was established the most important factor in the prevention of the sympathetic ophthalmia.

Prophylactic evisceration

From time to time various substitutes for prophylactic enucleation have been offered. In the light of our present knowledge of the disease many have proved fallacious, and none have been found as effective.

Of these, evisceration has been most widely accepted. This operation was performed by Noyes,[3] in 1872, and by Williams[28] of Boston five years later, but it was not popularized until introduced by Alfred Graefe[3] in 1884. It was soon adopted by Mules[3] on the ground that it was a less dangerous operation and furnished a better stump for an artificial eye.

The question of the adequacy of this measure was soon raised and its discussion still continues, for the fact that evisceration leaves a part of the eye connected with the optic nerve was not lightly dismissed.

To overcome this objection Huzinga[29] (1900) combined evisceration with excision of the optic disc and a piece of the optic nerve. Although this was considered an improvement, it did not entirely remove the objection because of the occasional retention of uveal tissue and the disclosure that the specific infiltration sometimes extended outside the globe.

Resection of optic nerve

During the latter part of the 19th century the prevailing opinion favored the theory of optic-nerve transmission of the causative agent. Hence, various methods were devised to interrupt the nerve pathway between the two eyes. The simplest procedure was severance of the optic nerve. However, the occasional occurrence of sympathetic ophthalmia after neurotomy and evidence both in animals and man that the cut ends of the nerve later united, led to the idea of its resection.[3] The failure of this procedure consistently to prevent the disease not only caused its gradual abandonment but also cast serious doubt upon the theory of optic-nerve transmission.

The tendency of many of the early writers to mistake other types of uveitis for sympathetic is quite obvious on reviewing the literature. This, together with their belief that sympathetic irritation was a phase of the disease, added further confusion to the extremely difficult problem of seeking to discover its pathogenesis. It was only after the underlying pathologic picture was understood that these extraneous conditions were largely eliminated. As a result, there followed an increasingly better clinical understanding of sympathetic ophthalmia.

Pathologic studies

Although many early observers, including Schirmer,[11] had made extensive pathologic studies, it was not until 1905 that it was pronounced a disease entity, distinct and apart from any other condition.

This was the work of Ernst Fuchs,[22] who

described in great detail the complete pathology of the disease and emphasized its salient and diagnostic characteristics. Little has been added to Fuchs's interpretation, and it remains today the keystone in the scientific study of the pathogenesis of sympathetic ophthalmia.

Subsequent studies by other investigators have, however, rounded out the pathologic picture, showing the tendency of the disease to involve other structures besides the uveal tract. Meller[23] described the frequency with which the retinal vessels are sheathed with lymphocytes. A. Fuchs[24] commented on the frequent occurrence of the specific infiltration in the sheaths of the optic nerve and its rarity among the nerve bundles. E. Fuchs,[25] in 1917, had pointed out that sometimes the inflammation may invade and even perforate the sclera with resultant extraocular proliferation.

Samuels[25] (1933), in studying this phase, concluded that involvement of the sclera is the rule and that, in severe cases, the process is essentially a uveoscleritis. He expressed the belief that the destruction of scleral tissue may be an important factor in the severity and long duration of certain cases, and that scleritis and tenonitis may often account for the severe pain which frequently occurs. He emphasized the likelihood of extraocular proliferation of the specific infiltration, particularly posteriorly, and warned that this possibility must be kept in mind when performing prophylactic enucleation.

The true significance of Fuchs's classical description of the pathology of sympathetic ophthalmia is shown by the fact that it has furnished the only certain means of diagnosis. Nevertheless, since the picture resembles other types of granulomatous uveitis, differentiation may be difficult in atypical cases.

This has not only caused trouble in diagnosis, but has been the basis for some pathogenic theories, notably the tuberculous hypothesis. More recently DeVeer,[26] upon finding features both of endophthalmitis phacoanaphylactia and sympathetic ophthalmia, suggested that sensitization to lens protein might be a direct precursor of sympathetic inflammation.

The revealing histologic studies offered by Fuchs stimulated added interest in pathogenic inquiries of sympathetic ophthalmia. They particularly encouraged a bacterial approach to the problem, for the histologic picture resembled that caused by an infection.

There followed renewed attempts to discover the offending organism but all ended in failure. Hence, the early enthusiasm was gradually dampened and many investigators strayed away from the fold to seek other methods of attack. As a result, there evolved two diverse theories to account for the disease:

One, that it was caused by an infection, and the other, that it represented an anaphylactic reaction. Most of those who upheld the infectious theory ultimately narrowed down the number of suspected organisms to the tubercle bacillus and some unidentified organism, probably a virus.

Tuberculous theory

As previously stated, Meller[21] had for some time contended that the organism causing sympathetic ophthalmia was already present in the blood stream at the time of injury. Impressed by the granulomatous nature of the inflammation and its pathologic resemblance to tuberculous uveitis, he later proposed the idea that the offending organism was the tubercle bacillus and that the two conditions were alike in origin and character.[30] In this, he was joined by many continental investigators particularly those of the Vienna influence.

The theory did not receive widespread recognition for some time. The height of its popularity was reached during the 1930s. However, it has never proved acceptable to most American ophthalmologists.

It was Meller's contention that tubercle bacilli circulating in the blood stream are

precipitated in the exciting eye as the result of the injury, and then produce the picture of sympathetic ophthalmia which is really a progressive tuberculous uveitis. He explained the involvement of the fellow eye as due to the possible biologic affinity of tubercle bacilli for uveal tissue as the result of their growth in the injured eye.

It was suggested by Loewenstein[31] that the degenerating cells at the site of the original metastasis in the exciting eye become foreign bodies and act as antigens; and that the absorption of these highly specific antibodies injures the second eye in such a manner that, when tubercle bacilli circulating in the blood finally reach it, they are able to germinate and thus produce the picture of sympathetic ophthalmia in this eye.

Guillery,[32] who did extensive animal experimentation in attempting to confirm the tuberculous theory, concluded that the presence of the bacilli themselves in the eye is not necessary, but that their toxins are sufficient to produce the lesions.

The report by Loewenstein that he frequently found systemically innocuous tuberculo-bacillemia in apparently healthy individuals led to the study of its occurrence in sympathetic ophthalmia. Not only was this found to be true in many cases but, even more significant, positive cultures, and in one instance the organisms themselves were obtained in affected eyes. These factors added strong support to the tuberculous theory.

There were, however, many dissenters to the idea, and some investigators were either unable to confirm Guillery's conclusions that he had created a tuberculous uveitis in rabbit eyes, or contended that he had misinterpreted his results.

Von Szily[33] failed to produce characteristic lesions, and both Meesmann and Volmer[34] and Marchesani[35] questioned his conclusions. de Andrade[36] was able to produce similar lesions by using nontuberculous substances and, in other experiments, he found no evidence for the tuberculous origin of sympathetic ophthalmia in man.

Riehm,[37] although agreeing that the uveitis in the second eye was tuberculous, maintained that the bacilli originated from an intrathoracic focus, not from the injured eye.

Poos and Sartorius[38] contended that the reaction was just a part of the general reaction of the reticulo-endothelial system to the tuberculo-toxemia, and hence has nothing to do with sympathetic ophthalmia.

Peters,[39] although apparently rejecting the tubercle bacillus as the offending agent in sympathetic ophthalmia, was struck by the clinical resemblance to tuberculous uveitis. Hence, he suggested that, if there be a causative organism, it is likely to be of endogenous origin and to possess biologic qualities very similar to those of the tubercle bacillus.

Comment

One of the chief arguments used against the tuberculous theory has been the inability of other investigators to obtain positive cultures in using the Loewenstein technique. Moreover, several objections remain even if the validity of his work is admitted.

It does not explain the immunity of the other organs of the body or the generally negative tuberculin reaction in children with sympathetic ophthalmia. Also, it fails to account for the extreme rarity of the disease following nonperforating trauma, for if this theory were valid perforation would not be necessary to cause sympathetic ophthalmia.

Although all of these factors tend to disprove the tuberculous origin of sympathetic ophthalmia, the most striking argument against it is the fact that the pathologic pictures of sympathetic disease and tuberculous uveitis, while similar, are not identical.

The virus theory

Beginning with Deutschmann's experiments with cocci, many different organisms have been suspected as the cause of sympathetic ophthalmia. Although most proponents of the infectious theory now believe a virus

is the inciting agent, this view has not received universal support.

Ormond and Price Jones,[40] in 1910, suggested a protozoal origin of the disease because of an accompanying mononucleosis in three cases of sympathetic ophthalmia. This was followed by a flurry of blood studies by various investigators, several of whom confirmed the authors' findings. However, in general, the results were not constant and the enthusiasm gradually subsided within the next few years.

More recently Waldman[41] (1935) has proposed that the Pfeiffer bacillus, or one of its group, is the pathologic agent. Impressed by the identical histologic findings of serous iritis and sympathetic ophthalmia, he stressed their clinical similarities, and sought to explain their occurrence on a common basis. He demonstrated, both by his own cases and by international statistics, that sympathetic disease, like serous iritis, occurs preponderantly in the cold damp months of the year, and that it rarely appears in hot arid regions.

The presence of nasal congestion in cases of sympathetic ophthalmia which were cured by treatment of the nose and sinuses led Waldman to believe that he had discovered the habitat of the organism. He expressed the opinion that the etiologic agent, probably the Pfeiffer bacillus or one of its group, migrates into the conjunctival sac from the accessory nasal sinuses. According to Waldman's reasoning, the organism enters the eyeball upon its perforation, and reaches the second eye either by way of the ciliary nerves with involvement of the sympathetic nervous system, or by way of the optic nerves. In the former case there is anterior uveal involvement, in the latter complete uveitis.

Zur Nedden[42] (1905), who first proposed that a virus might be the infecting agent, suggested that the organisms already in the conjunctival sac entered the exciting eye with its perforation. This idea received added credence with the subsequent evidence that the herpes virus readily travels from one eye to the other.

Von Szily,[43] in 1924, was able to produce a definite inflammation which somewhat resembled sympathetic ophthalmia in the second eye after injecting herpes simplex in a pouch behind the ciliary body of rabbits.

This work was confirmed two years later by S. R. Gifford and Lucie,[44] who provided additional evidence that the infection traveled by way of the optic nerves and chiasm by obtaining positive inoculations from points along this course and also by inoculation in the region of the chiasm which resulted in uveitis of both eyes.

Although these experiments showed that, in rabbits, the herpes virus was capable of inciting inflammation in the two eyes in a manner which was comparable with that occurring in man, it did not prove that the inflammation was sympathetic ophthalmia. Moreover, with the exception of Von Szily's[45] (1934) successful production of a nodular infiltration in the eyes of chicks and a monkey, there has been quite uniform failure in reproducing inflammation in animals from inoculation of filtrates from human eyes affected with sympathetic ophthalmia.

The reasons given for these failures have been the supposition that the hypothetical virus is short lived, or requires special culture-media, or that animals are immune to the organism. In any event, it became apparent that the problem could not be solved by animal experimentation.

During the past 30 years, the study of the pathologic anatomy of affected globes has done much to promote the infectious theory. One of the most significant findings in this respect was the discovery of primary lesions of inflammation in the area of perforation. Redslob,[46] in 1921, first called attention to this lesion, terming it the chancre of inoculation. Four years later, Marchesani[35] reported similar observations.

Fliri[47] argued that this was a misinterpretation and that it only represented evidence of a localization of microörganisms which were already circulating in the blood stream before the occurrence of the injury. Further-

more, he maintained that, if sympathetic ophthalmia were due to a primary infection, the primary lesion must always be present.

Samuels,[48] in 1932, took issue with Fliri's objections, calling attention to the fact that contusions may severely damage uveal tissue without the appearance of local specific infiltration. Besides, he contended that failure to find a primary lesion regularly was immaterial so long as any at all were discovered. He pointed out that primary infection may very well occur without a primary lesion and also that a primary lesion may be so insignificant or hidden as to escape notice.

In his study, Samuels found two instances of primary infiltration and nine in which the infiltration was overwhelmingly greater in the region of the wound than elsewhere. Further investigation disclosed that the infiltration in the anterior portion of the uvea appeared to be older than that in the posterior portion. Moreover, in certain cases the path of the infiltration could be traced by continuity from the wound site to the choroid.

Samuels concluded that he had demonstrated the primary site of infection and the manner in which the process extends in the exciting eye.

Both Samuels and Redslob have been much impressed by the pathologic findings in their investigations. It has led them to accept the theory that sympathetic ophthalmia is caused by a virus which enters the eye at the time of injury. Since the specific infiltration is predominantly confined to the uvea in this disease, the theory presupposes either a high sensitivity of this tissue or a selective affinity for it on the part of the virus. In either event, it is presumed that the virus lodges in the uvea and, as the result of an irritation, produces the specific infiltration which spreads to other parts of the uvea, and thence passes through the blood stream to the uvea of the other eye.

In those cases in which sympathetic ophthalmia breaks out long after the injury, Samuels assumed that the virus has lain dormant in the tissue. Since it is believed that the organism is already in the blood stream, this theory also explains why enucleation has little or no effect after the disease has once started.

The idea of hematogenous infection goes back to Berlin's hypothesis which has previously been discussed. Although this theory has received some elaboration, nothing factual has been added in the 72 intervening years. According to Redslob's conception, which is quite representative, the organisms leave the injured eye and enter the blood stream where they multiply during the latent period. This is followed by a bilateral hematogenous infection through the ciliary arteries which attacks the two eyes with about equal intensity at approximately the same time.

In Redslob's[49] opinion, the concept of hematogenous infection is supported by the evidence of meningeal irritation in sympathetic ophthalmia, such as lymphocytosis of the spinal fluid, headache, and deafness. He has assumed that since the hypothetical virus seems to be specific for the vascular tunic of the eye, it should likewise be specific for such corresponding tissues as the pia mater and the arachnoid plexus of the brain.

A. Loewenstein[50] (1945) has proposed an explanation quite different from that of Samuels and Redslob. According to his conception, a saprophytic neurotrophic virus of the conjunctiva enters the eye at the time of injury, and then creeps along the ciliary or optic nerves to the brain and ultimately to the other eye. He has attributed the inflammation in the second eye to an allergic reaction with release of an H substance at the nerve endings, which is caused by the repeated reabsorption of the virus.

One of the most encouraging and exciting pathogenic studies of sympathetic ophthalmia has been recently reported by Schreck.[51] He has based his results on animal experimentation and on the examination of human material—notably the eyes, the optic nerves, and the chiasm of a patient with long-standing sympathetic ophthalmia who had died of

brain tumor. His work, if confirmed, assumes particular importance because of his contention that he has furnished unequivocal proof of the cause of the disease and has provided a means of early accurate diagnosis.

According to Schreck, the inflammatory process is transferred from one eye to the other by way of the optic nerves and the chiasm. He observed, both in animals and in the human material, a migrating continuous periangiitis and perineuritis along these structures extending from the exciting eye to the sympathizing eye. Moreover, examination of sections of the pathway disclosed a microbic agent similar in size, shape, and staining properties to a Rickettsia.

Inoculation into the eyes of chickens produced the typical picture of sympathetic ophthalmia. This is a most remarkable occurrence, representing the first instance in which the complete picture of the disease has been produced in a lower animal.

The pathologic characteristics of the agent were also shown by extraocular inoculation, for the infective agent elicited changes in various organs of the test animals, and the organism was observed in the histologic preparations.

Schreck's later experiments were even more dramatic. In these, he was generally successful in reproducing sympathetic ophthalmia in chickens by the intraocular inoculation of uveal material from human exciting eyes, and of the aqueous from both the exciting and sympathizing eyes. This occurred in continuous transfer from chick eye to chick eye up to five passages, and in one instance six passages.

The failure to reproduce the disease in pigeons, rabbits, and guinea pigs not only intimated to Schreck that the chicken might commonly act as host to the organism, but made it seem probable that no other organisms are involved in the process.

Schreck expressed the belief that the exciting agent remains stationary as a saprophytic harmless parasite in the conjunctiva and neighboring tissues and only becomes virulent when coming in contact with uveal tissue after perforation of the globe.

In his experiments Schreck was able to demonstrate the growth of the microörganisms if the aqueous of patients with sympathetic ophthalmia was inoculated on the chorioallantois of the chick embryo. He suggested, therefore, "that use be made of these facts by performing a diagnostic puncture of the anterior chamber of an eye suspected of having sympathetic ophthalmia, and immediately inoculating the warm material on the chorioallantois of chick embryos." He further suggested that, since the exciting agent of sympathetic ophthalmia seemed to be one of the Rickettsia group of organisms, appropriate antirickettsial therapy should be utilized.

The results of Schreck's investigations furnish a rational explanation for the occurrence of sympathetic ophthalmia and present a means for its early diagnosis. Furthermore, they provide a firm basis on which to conduct studies for its prevention and treatment. Nevertheless, in spite of the elaborateness of the experiments they were not well controlled.

This fact was brought out by Adler[52] who criticized the failure to utilize control inoculations from nonsympathetic eyes. This seemed particularly important because of Schreck's suggestion that the organism may lie dormant in the intraocular tissues and be activated when it comes in contact with the uveal tissue.

It is obvious that the validity of Schreck's conclusions must await confirmation by other workers. Meantime, it is well to keep in mind the past history of investigations to solve the pathogenesis of this dread disease, in which many apparently logical explanations have fallen by the wayside through lack of confirmation.

Comment

Of all the theories which have been proposed, that of infection is the most simple and rational. In general, sympathetic oph-

thalmia presents the characteristics of an infectious process. This applies to its usual occurrence only after perforating wounds, its clinical course, and its pathologic picture. However, as in the other theories of the disease, the essential factual elements are lacking. Hence, it must still remain only another hypothesis.

For this theory, with the exception of Schreck's unconfirmed results, only assumes that a virus is present in the injured eye, and provides no evidence that it has an elective affinity for uveal tissue, or that this tissue is hypersensitive to it. Moreover, there is no evidence that a virus circulates in the blood stream, and only unconfirmed evidence that it traverses the optic pathway and invades the sympathizing eye.

Anaphylactic theory

The simplicity and logic of the infectious theory of sympathetic ophthalmia is apparent throughout the history of the search for its pathogenesis. But the failure to discover an organism capable of producing the disease has been such an important missing link in the chain of evidence that it led many investigators to abandon the bacterial approach. This fact, together with increasing knowledge of the chemical action of the body proteins, stimulated interest in the possibility that sympathetic ophthalmia might be caused by biochemical changes.

Pusey[53] (1903) seems to have been the first to propose such a theory. He suggested that the cells of the injured eye, probably those lining the ciliary processes and the iris, might produce a specific cytotoxin which circulating in the blood stream acts upon similar cells in the second eye.

About a year later Golowyn[4] advanced a similar theory, but with the additional supposition that the damage caused by the toxins in the second eye provided a favorable site for attack by organisms circulating in the blood.

In criticising this theory Schirmer pointed out that noxious elements after removal of the primary focus of infection gradually diminish in toxicity. Hence, in view of the occasional occurrence of sympathetic ophthalmia some time after prophylactic enucleation, and the frequent occurrence of recurrent exacerbations of sympathetic inflammation for months after removal of an offending eye, he maintained the hypothesis was untenable. At about the time these theories were proposed, discussion had begun regarding anaphylaxis as a possible cause of sympathetic ophthalmia.

Elschnig-Woods theory of uveopigmentary sensitization

Although anaphylaxis as a cause of sympathetic ophthalmia had been discussed earlier, Elschnig[54] was the first to present a clear description of a workable theory supported by experimental facts. In 1910, he advanced the idea that sympathetic ophthalmia was the result of an anaphylactic reaction in which uveal pigment acted as the antigen. His theory assumed that a perforating wound involving the uvea may cause liberation, dissemination, and absorption of the pigment.

Since the uvea is the only structure containing this pigment, he postulated that its absorption produced hypersensitivity to it of the uvea of both eyes. He maintained that further absorption acted as a shocking dose, causing an anaphylactic intoxication of the sensitized uveal tissue of the uninjured eye, and resulted in the clinical picture of sympathetic ophthalmia.

Elschnig's theory was based on complement-fixation studies indicating that the pigment of the uveal tract was the uveal constituent responsible and that it was capable of acting as an antigen in the homologous animal, and that it was organ specific but not species specific.

These findings were confirmed by Weichardt and Kummel,[55] and later by Kummel,[56] but were questioned by Rados,[57] Fuchs and Meller,[58] and von Szily.[58]

In 1916, Woods[59] repeated Elschnig's work and, with one minor exception regard-

ing species specificity, confirmed his original results.

These experiments were again repeated and confirmed by Nakamura,[55] and later partially confirmed by Kodama,[60] who concluded that the active agent need not be uveal pigment alone, as other elements in the uvea and in other ocular tissues may also act as antigens. In studies of the mode of absorption of uveal pigment in man, Henton[61] offered further proof of its organ specificity.

Since 1916, Woods has taken the dominant role in the investigation of the antigenic properties of uveal pigment, and the present status of the allergic theory is largely due to the results of his studies. The immunologic properties of uveal pigment have been substantiated, and it has been established that, after an injury to the uveal tract, the pigment may be absorbed and produce an immunologic reaction.

Woods[62] was able to produce uveitis in the fellow eye after intraocular sensitization of dogs with uveal pigment and subsequent inoculation by intraperitoneal injection. He also found that antibodies specific for uveal pigment were usually present in patients whose eyes healed normally, but were absent when the inflammation was prolonged and when sympathetic ophthalmia developed.[63]

These findings were not entirely confirmed by Fodor[64] who, while he demonstrated the occurrence of such antibodies in many cases, did not concur as to their appearance in specific conditions. He agreed as to their absence in sympathetic ophthalmia, but he found them only irregularly in eyes which healed uneventfully, and also found them in some cases of retinitis pigmentosa and in other diseases of the uveal tract.

Gifford[65] failed to find antibodies in four patients, two of whom had sympathetic ophthalmia. With the development of more modern immunologic ideas, Woods[66] later concluded that he had exaggerated the significance of the appearance of antibodies in his earlier studies.

Because of the technical difficulties and the delay in the appearance of the antibodies in the complement-fixation reaction, Woods[67] supplanted it by the less complicated and quicker acting intradermal sensitivity test. Using uveal pigment as an antigen, Woods and Little[68] found that true hypersensitivity to uveal pigment occurred only after penetrating wounds of the uvea, and that it indicated either the presence of a very serious uveitis of the injured eye (the false-positive test), or the occurrence of sympathetic ophthalmia.

In later studies, McPherson and Woods[69] discovered that this hypersensitivity also occurred in the Vogt-Koyanagi syndrome. This observation would seem to be quite significant since, because of the histologic and clinical resemblance of this condition to sympathetic ophthalmia, many attempts have been made to explain it on an allergic hypothesis. The basis for this idea was Elschnig's[70] contention that alopecia and poliosis in association with sympathetic disease resulted from the antigenic effect of uveal pigment, the hair being involved because of its richness in pigment.

Woods and Little noted that, even in patients with sympathetic ophthalmia, the response was not always positive, a negative reaction occurring during acute exacerbations. This led to the assumption that there may be periods in the disease showing a negative phase similar to those found in certain stages of acute tuberculosis, in which the reaction to tuberculin may be negative.

The evidence of relationship of uveal pigment allergy to sympathetic ophthalmia received substantial support from Jonas Friedenwald's histologic studies.[71] Since, according to the Elschnig-Woods theory, uveal pigment is the antigen responsible for the pathologic reaction in sympathetic ophthalmia, Friedenwald speculated that pigment granules within the phagocytic cells should be found in the centers of the lesions; for if the disease is allergic, the specific antigens should be demonstrable in the specific lesions.

In his investigation, he found that not only were the epithelioid cells and giant cells of the uveal tract filled with stainable granules, but so were those in episcleral and retinal nodules.

The retinal findings were particularly significant, for the picture was quite different from that found in other pigmentary disturbances of this tissue. The characteristic feature was the fact that whenever melanin pigment was deposited in the retina, the granules were engulfed by epithelioid cells and giant cells and surrounded by an inflammatory infiltration which had all the characteristics of the specific lesions of sympathetic ophthalmia.

The presence of these nodules raised the question as to how far the characteristic inflammatory reaction of sympathetic ophthalmia might be considered as due solely to an allergic reaction to the pigment granules.

The question was answered by studying histologically the reaction in the skin to a local injection of a suspension of uveal pigment. Friedenwald found that two weeks after injection the histologic picture of the excised skin was identical to that of the ocular reaction in patients with active sympathetic ophthalmia. On the other hand, in normal and insensitive individuals, the picture was quite different.

He concluded that the disease had been reproduced in the skin of a susceptible individual by the local injection of the presumed specific antigen. He further concluded that the characteristic pathologic changes found in this disease are compatible with the allergic hypothesis.

Alexseev[72] made similar histologic examinations of the excised cutaneous segments in six cases, five of which showed clinically positive skin tests. The one clinically negative case proved to be positive histologically.

On the assumption that allergy to uveal pigment is at least a fundamental factor in the production of sympathetic ophthalmic, Woods[66] presumed that, theoretically, this factor should be removable by desensitization with the specific allergin. Using uveal pigment injected intramuscularly, he sought specifically to desensitize patients with sympathetic inflammation.

As the result of many years' observation involving a comparatively large number of patients, he believes the therapy to be specific and of true value.[68] However, uveal pigment is an insoluble and feeble antigen, and its absorption is slow so that desensitization is a long drawn-out process.

Friedenwald[71] obtained a more rapid desensitization by exposure of the skin of the body to ultraviolet light. His purpose was to produce a proliferation of the melanophores of the skin, so the body might be provided with a readily available and widely distributed supply of pigment antigen.

Variations of Elschnig-Woods theory

Several variations of the Elschnig-Woods theory have been proposed. Oguchi[73] expressed the belief that liberated chromatophores are responsible for sympathetic inflammation. According to his conception, trauma of the uvea frees immune bodies which attack and destroy the neighboring chromatophores until this change takes place in the entire uvea.

The liberated and wandering chromatophores, which act as antigen and as allergen, produce an allergic infiltration when they are in sufficient quantity, or the tissue is electively sensitized. If the liberated chromatophores pass on to the other eye, sympathetic ophthalmia ensues. The pathway may be the blood stream, the optic nerve, or the orbital-facial venous system.

Marchesani[74] apparently believes that nonspecific bacterial protein absorbed from the eye produces a paired organ sensitivity of the two eyes, making it possible for the bacteria to localize in the second eye. He based his conclusions on rabbit experiments in which he produced a histologic picture somewhat resembling sympathetic choroiditis in the fellow eye by repeated intravitreal

injections of broth cultures of bacillus subtilis.

His conclusions are, however, open to serious doubt, for his assumption that the reaction was allergic has been challenged by Iga[75] and Kiyosawa[76] who, separately, repeated the experiments and concluded that the reaction was due to bacterial metastasis. Their contention received support from the fact that Friedenwald and Rones[77] found lesions almost identical to those described by Marchesani in eyes of patients who had died of general septicemia.

Riehm[78] reported experiments in which he found that repeated intraocular injections of foreign protein (horse serum) produced sensitivity of the fellow eye in pigmented rabbits, but caused no reaction in albinos. He considered the process to be an elective sensitization of paired organs rather than sympathetic disease.

He expressed the belief that sympathetic ophthalmia following perforating wounds was due to an unknown infective agent which acts as an antigen only in human uveal tissue, and sensitizes the uvea of both eyes—an anaphylactic inflammatory reaction to a bacterial antigen.

On the other hand, he regarded the reaction as purely allergic, with elective sensitization of the fellow eye, in sympathetic inflammation following such conditions as intraocular melanoma and subconjunctival scleral rupture.

Schlaegel[79] repeated Riehm's experiments but used smaller and fewer doses of horse serum. He found a minimal response in the fellow eye and an equal reaction in pigmented and albino rabbits. However, he did not consider that the results of his investigation had discredited the pigment-allergy hypothesis.

These unrelated modifications serve to demonstrate by contrast, the rationalism and the careful integration of the Elschnig-Woods theory of uveopigmentary sensitization.

COMMENT

The allergic theory has received much searching criticism from the time of its inception. Objections have been raised against nearly every phase of its hypothesis. Increasing knowledge of immunologic processes has eradicated some points of criticism, and others have been explained more or less satisfactorily by subsequent investigations, but some still remain unanswered.

One of the chief criticisms of Elschnig's original theory was his contention that one of the body tissues was capable of acting as an antigen. This was in conflict with the immunologic rule, since disproved, that an animal cannot be sensitized against his own protein, the "horror autotoxicus" of Erlich. Collins,[80] in 1949, reviewed the reasons for the validity of autoallergy.

The second phase of this hypothesis has also received much criticism. According to Elschnig, after sensitization has occurred, further absorption produces the shocking dose causing anaphylactic intoxication. It was argued that, if this were true, there would have to be an interval between the sensitizing and shocking doses in which no antigen was in circulation, on the assumption that the state of anaphylactic shock can occur only when the whole of the sensitizing dose has disappeared.[81]

This would mean that uveal pigment must be set free from the injured eye a second time, but not until the pigment produced by the original injury has completely disappeared from the circulation; and this would seem to be a most unusual circumstance to occur during the course of traumatic uveitis.

This objection was based on the false premise that there must be an antigen-free period between sensitizing and shocking doses. That this is not true has been demonstrated by such conditions as serum sickness, the positive reaction to tuberculin in active tuberculosis and many other conditions.

The cornerstone of the allergic theory is the assumption that uveal pigment is the

antigenic substance involved in the process. The failure of some investigators to confirm its immunologic reaction has caused them to reject the whole idea. Others have questioned the specificity of the immune response, contending that some other substance than the pigment may be the antigenic agent. In any event, many workers[64, 72, 82–85] have not found the uniform clinical results, in using the skin test, noted by the Wilmer group and by Gill.[86]

The resemblance of the histologic picture of sympathetic ophthalmia to that produced by infectious agents, rather than by any known allergic reactions, has been frequently cited as conflicting with the allergic theory.

Friedenwald[71] has denied any such conflict by pointing out that allergic reactions play at least some part in the histologic changes which take place in infected tissue in general. He maintained that the train of events in sympathetic ophthalmia might be compared to that in tuberculosis, in which an allergic reaction dominates the process, and hence determines the characteristic histologic picture.

Friedenwald provided further evidence of the similarity of allergic reactions and sympathetic disease by his histologic skin studies previously described. Also Schlaegel and Davis[87] produced a pathologic picture of allergic origin resembling sympathetic ophthalmia by injection of horse serum in the opposite eyes of sensitized rabbits.

Since the optic nerve ordinarily does not contain pigment, the appearance, in some cases, of papillitis as an early and prominent symptom of sympathetic ophthalmia has been difficult to explain on an allergic basis. Kodama[60] has accounted for its occurrence on the assumption that the active agent of the disease need not necessarily be the pigment. On the other hand, Friedenwald[88] has expressed the belief that participation of the optic nerve in these cases may be due to the occasional presence of pigment in its anterior regions.

Another argument used against the allergic theory has been that prophylactic enucleation of the exciting eye would be of no value once sensitization had occurred, and that any subsequent disturbance of the remaining eye might provide another shocking dose. Moreover, the trauma resulting from prophylactic enucleation might be sufficient to act as a shocking dose in causing the disease.

These questions have never been satisfactorily answered. However, it has been pointed out that removal of the exciting eye should act to prevent the further absorption of uveal pigment from it and thus tend to prevent the occurrence of the shocking dose; and that the trauma caused by enucleation might account for the occasional occurrence of sympathetic ophthalmia after prophylactic removal of the injured eye.[89]

There are two factors which provide quite definite proof that sympathetic involvement is not a purely allergic reaction. These are: (1) The fact that it does not follow nontraumatic uveitis and other conditions in which there is uveal disturbance; and (2) the occasional occurrence of hypersensitivity to uveal pigment in patients who do not develop the disease.

The occasional appearance of the false-positive skin reaction in these cases led Woods[90] to modify Elschnig's original theory. His present conception is that the development of allergy to uveal pigment apparently sets the stage for the production of sympathetic ophthalmia by disturbing the immunologic defense mechanism, and that it determines the histologic picture, but that some other unknown factor must be present to initiate the onset of the disease.

The most perplexing feature in this theory is the direct inciting cause. The most generally accepted opinion is that an exogenous infection enters the blood stream and becomes localized in the sensitized uninjured eye. It has been suggested that some unidentified organism or virus may be the infecting agent, or that tubercle bacilli become

lodged in the eye, or that the reaction is tuberculo-toxic. However, the whole matter is entirely speculative and it is possible that the inciting factor is entirely nonspecific.[91]

Friedenwald[71] has suggested the novel theory that the additional factor necessary to initiate the inflammatory reaction is a proliferation of the intraocular melanophores which releases the uveal pigment and makes it available for allergic reaction. He explained his hypothesis as follows:

"In some cases following an injury to the eye, the body becomes hypersensitive to uveal pigment. This alone is not sufficient to elicit the disease, for cells containing melanin granules show no abnormal reaction, in their resting state, to the presence of allergic antibodies. When, however, such cells proliferate, they become vulnerable to the antibodies, and undergo autolysis, releasing their melanin granules, which in time elicit the allergic inflammatory reaction."

The pathogenic effect of the melanin granules, and especially of the precursors of melanin, was investigated by Spyratos,[92] who concluded that they act as virulent proteins. However, it is improbable that melanin is the actual inciting agent since it is not thought to contain lipoids or fatty acids[93] which are believed to be essential to the production of the type of granulation tissue found in sympathetic ophthalmia.[94]

The proponents of the allergic theory have built up a strong case in support of their contention that uveopigmentary sensitization is an essential element in the production of sympathetic ophthalmia. This theory readily explains the long incubation period of the disease, the failure to find any specific organism, and the rather uniform presence of hypersensitivity to uveal pigment. It also explains its infrequent occurrence, since only a relatively small number of individuals have an allergic tendency. Moreover, it explains the presence of extraocular symptoms.

On the other hand, the presence of factors which are not harmonious with the hypothesis indicate that either the theory is not valid or something besides allergy enters the picture.

Summary

It is evident that an enormous amount of effort has been expended in the attempt to solve the pathogenesis of sympathetic ophthalmia. The problem has engaged the attention of the best minds in ophthalmology and allied fields for over a hundred years, and yet so far it has not been solved. Consequently, there is no method of determining individual susceptibility to the disease, or of ascertaining the imminence of its onset, and there is no specific therapy for its prevention or treatment.

It is not strange that many of the earliest theories were incongruous. The disease was little understood, the knowledge of bacteriology was limited, and the physicochemical reactions of the body proteins were unknown.

Along with the advances in comprehension of disease processes in general, there has come a better understanding of the problem of sympathetic ophthalmia, and much valuable information has evolved through the observations made down through the years.

Particularly impressive are those of some of the early workers, the most noteworthy of which were: the clear conception of sympathetic ophthalmia as described by MacKenzie (1840); the favorable effect of removal of the injured eye as demonstrated by Pritchard (1851) and by Critchett (1863); critical surveys of the disease by Randolph (1898) and by Schirmer (1900); and the classical histologic studies of Fuchs (1905).

There was thus established a foundation upon which to base subsequent investigations.

The problem of discovering the pathogenesis of sympathetic ophthalmia has been particularly difficult because, with the possible exception of Schreck's recently unconfirmed work, results have been unsuccessful both in producing the disease experimentally and in finding an offending agent. Hence,

there is so little factual evidence at hand that any explanation offered must be largely hypothetical.

At the present time, the two most generally accepted theories are that it is produced by an infective agent or that it is the result of an allergic reaction to uveal pigment. The proponents of the infectious theory have narrowed down the number of suspected organisms to the tubercle bacillus and some so far unidentified organism, probably a virus.

The fact that the histologic pictures of sympathetic ophthalmia and tuberculosis uveitis, while similar are not identical, mitigates against the tuberculosis theory. Moreover, the case is materially weakened by the inability of others than those of the Vienna School to isolate tubercle bacilli from the eye and blood stream and the fact that sympathetic disease almost never occurs except after perforation of the globe.

The apparent infectious nature of sympathetic ophthalmia, together with the failure in finding an offending organism, has led to the idea that it might be caused by a virus.

According to this theory, the virus enters the eye at the site of the injury, or possibly it is already in the blood stream and lodges in the uvea after it is traumatized. It is then thought to produce an irritation which results in the specific infiltration of sympathetic uveitis in the injured eye.

Histologic evidence presented by Redslob, and particularly by Samuels, indicates the progress of the specific infiltration from the wound site through the iris and ciliary body and thence to the choroid, and in some cases to the external surface of the globe. It is assumed that the fellow eye becomes involved because of a selective affinity of the virus for uveal tissue, or possibly because of a high sensitivity of this tissue.

The most logical route for the virus to reach the second eye would seem to be by way of the optic pathways. Such was found to be true in Schreck's unconfirmed experiments. However, several objections to this route have been raised.

It has been argued that transmission by way of the optic nerve or its sheaths is unlikely since inflammation of the iris is almost always the first clinical evidence of the disease. Moreover, so far as the sheaths are concerned, no histologic evidence of their infiltration has been proved. Furthermore, the pattern of infiltration found in the optic nerve of the second eye is not congruous with what one would expect in a descending process.

The idea that the virus might travel by way of the ciliary nerves is not compatible with the facts at hand, since apparently no anatomic connection exists between the ciliary nerves of the two eyes. Hence, by the process of elimination, there has evolved the more complicated hypothesis of transmission of the virus by the systemic blood stream.

The usual occurrence of sympathetic ophthalmia only after perforating wounds, the nature of its clinical course, and the appearance of its pathologic picture are all characteristic of an infectious process. However, the inability to discover an offending organism presents an essential missing link in the chain of evidence.

Full acceptance of this theory requires proof that a virus is actually present in the injured eye, and that it invades the uvea of the sympathizing eye. It is possible that Schreck has the answer to this problem. But, unless and until his work is confirmed, the idea that sympathetic ophthalmia is an infectious process remains unproved.

The proposal that sympathetic ophthalmia is an allergic reaction in which uveal pigment acts as the antigen has many attractive features. It readily explains the long incubation period of the disease, the failure to find any specific organism, and the rather uniform hypersensitivity to uveal pigment. It also explains the infrequent occurrence of sympathetic ophthalmia, since only a relatively small number of individuals have an allergic tendency.

Although this is a most complete and carefully worked-up pathogenic theory, some elements are present in the disease which do not

harmonize with it. Two factors which provide quite definite proof that it is not a purely allergic reaction are: (1) The fact that sympathetic inflammation does not follow nontraumatic uveitis or other conditions in which there is uveal disturbance; and (2) the occasional occurrence of hypersensitivity in patients who do not develop the disease.

The occasional presence of this false-positive skin reaction led to modification of Elschnig's original theory. The present conception is that the development of allergy to uveal pigment is essential to the production of sympathetic ophthalmia by disturbing the immunologic defense mechanism but that some other unknown factor must be present to initiate the onset of the disease.

The essential missing element in this theory is the nature of the inciting factor. It is generally believed to be some form of an infectious process. Unless it is discovered, the allergic theory will still be viewed with skepticism by many ophthalmologists.

Conclusion

From the evidence presented by the various pathogenic theories it would appear that infection must be present to cause sympathetic ophthalmia and that a virus is the most likely offending organism. However, it seems not improbable that allergy to uveal pigment may be a factor in the production of the disease.

No field of medical research has offered a greater opportunity for theorizing than has the quest for the pathogenesis of sympathetic ophthalmia. It is to be fervently hoped that in the not too distant future theories will be supplemented by the marshalling of sufficient facts to solve this important and vexing problem.

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NOTES, CASES, INSTRUMENTS

HOMEMADE APPARATUS FOR TESTING RETINAL CORRESPONDENCE

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Anyone who is handy with carpenter's tools and who is also an amateur electrician can make an apparatus for testing retinal correspondence by using the after-images as described by Tschermak. The apparatus (fig. 1) has a wood base to which are attached sockets at right angles so that the frosted bulbs (40 or 75 watt) are at right angles to each other. At the middle of each bulb is a circle of black friction tape.

On one side of the instrument is an ordinary three-pole toggle switch by which the lights can be turned on alternately. On the cord, which is plugged to the 110 to 115 volt outlet, is a switch to turn off the current when instrument is not in use. Wiring diagram for the apparatus is shown in Figure 2.

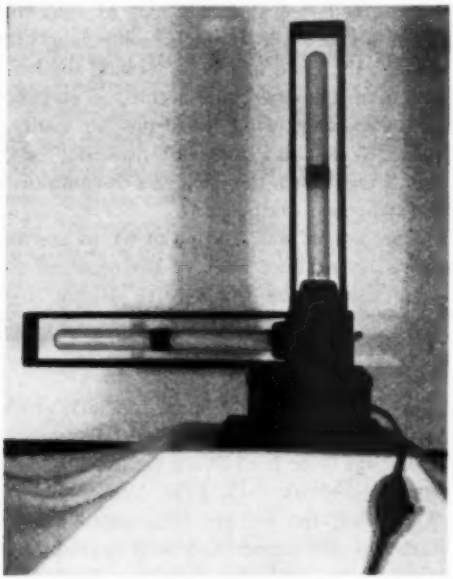

Fig. 1 (Ellenberger). The homemade apparatus for testing retinal correspondence.

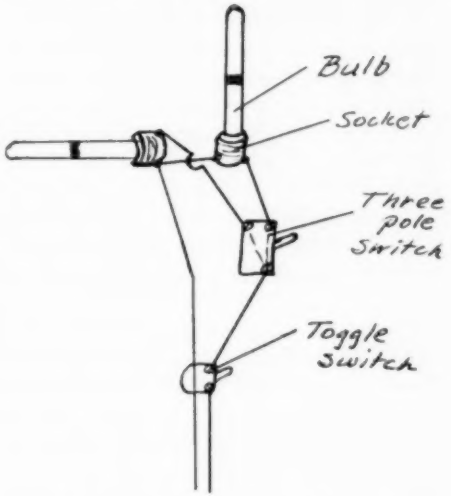

Fig. 2 (Ellenberger). Wiring diagram.

To use the apparatus it is placed about two feet in front of the patient in a darkened room. The poorer eye is first covered by the patient's and the examiner's hand and the patient is directed to look at the black tape on the horizontal bulb for 15 to 20 seconds.

Then the better eye is covered, the poorer eye being opened, and the switch is turned so that the poorer-seeing eye can be directed to the tape on the vertically placed bulb. I have found that the vertical after-image is easier to see so the nondominant or the eye with poorer vision is allowed to see the vertical bulb after the better eye sees the horizontal one.

The apparatus is then turned off and the patient is instructed to look to the distance in the darkened room and to open and close his eyes. First he is asked what colors he sees, to find out if he really sees the after-images. They are usually a delicate pink with a blue border.

Next he is asked in which direction the "lines" go to find out if he sees both the vertical and horizontal. Then he is asked if one line touches the other, and where it

touches; no mention of a cross is suggested either by word or by the construction or appearance of the instrument.

If the child does not quickly say he sees a cross, the examiner can help the child answer by using his index fingers to indicate if he sees a "T" with the cross piece on top or on the side. This method I have found gives better results than when the patient draws what is seen, since all this is done in a darkened room with positive after-images and the test is most always used on younger children who are unfamiliar with pencil and paper.

Seeing the after-images is facilitated by repeatedly having the child "open and close" his eyes, the positive after-images being seen immediately on closing the eyes. Then, of course, the negative (black) after-images can be seen on a light background in a well-lighted room even several minutes after seeing the lights.

I claim no superiority of this instrument over those made commercially except that it can be made in one's own basement and that its construction does not in any way suggest to the patient (usually a child) that he should see a cross.

Experience with this instrument over more than 10 years has shown that with abnormal retinal correspondence, proven with the Troposcope, seeing a cross is farthest from the patient's mind.

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SPECIAL REACTIONS TO THE MIOTIC, FLOROPRYL

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Floropryl, in addition to other miotics, has been used by me in various percentages for the treatment of some cases of convergent strabismus.

During treatment with Floropryl, and not with any of the other miotics, two children developed some general reactions to its local use.

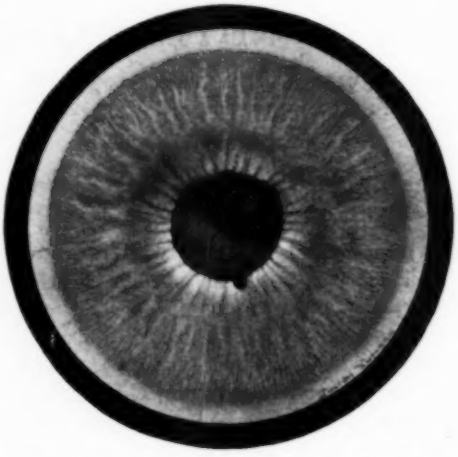

Fig. 1 (Abraham). Photograph of a drawing of cysts in an 11-year-old boy who had been using 0.02-percent Floropryl for eight months.

CASE REPORTS

CASE 1

A 10-year-old girl with anisometropia was given 0.01-percent Floropryl drops, one nightly in the right eye only, starting on May 26, 1951. One month later, the patient's mother reported that she had to stop the drops because she felt that something was wrong; the child had been wetting the bed, had been nauseated, and seemed to stagger. The day after using the drops the patient showed definite unusual yawning and stretching. When the drug was discontinued, the symptoms disappeared.

The patient was advised to try to use the drops again (once weekly) but reported the same reaction on further use so that they were discontinued.

CASE 2

A girl, aged eight and one-half years, with anisometropia was given 0.01-percent Floropryl to be used in the right eye nightly starting February 15, 1952. When seen on April 3rd, the mother commented on the fact that the patient had been developing a nervous tic and throwing her head back momentarily. She had never done anything

like this before and the mother wondered whether the drops could be the cause. The drops were stopped and this condition disappeared.

Discussion

Floropryl is di-isopropyl fluorophosphate, a drug which has definite toxic effects. It is 30 times more powerful than eserine. Although Floropryl is effective as a miotic, it is a noxious agent when entering the system through inhalation even in high dilution. It seems possible, therefore, that in sensitive cases a sufficient amount is absorbed through the mucous membrane of the conjunctiva and the nasal passages to produce toxic effects.

In addition, it has recently been noted that some of these children develop iris cysts even when only 0.005-percent solution of Floropryl is used. These cysts may become quite large (fig. 1). However, on discontinuing the drops the cysts tend to disappear.

Since similar but much smaller cysts appear in some adults who are being treated with pilocarpine or eserine, it cannot be said that the formation of these cysts is produced only by Floropryl. The findings thus far suggest that only when the pupils remain constricted do these cysts develop.

Further studies with the miotics are being conducted together with a study and analysis of the possible relationship of these cysts to glaucoma itself.

In the meantime, attention is called to these facts which suggest that careful observation of children using these miotics is necessary. A modification of the therapy in cases in which cysts form, not necessarily a discontinuance thereof, is indicated. In those patients who develop general reactions, the drug is best discontinued.

6363 Wilshire Boulevard (48).

UNILATERAL ANOPHTHALMOS*

Report of a case showing undifferentiated paraxial mesoderm

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and

H. N. Adhulia, M.B.

Agra, U.P. India

G., a man, aged 27 years, complained of complete absence of his right eye since birth.

Examination of right eye. The lids were normal, cilia were present on both lid margins, the palpebral fissure was narrow, the puncta normal.

Syringing of the lacrimal sac could not be done, indicating obstruction of the nasolacrimal duct.

The fornices and conjunctival sac were normally developed. No eyeball could be detected. The conjunctival sac was opened and a rudimentary nodule was found. It moved synchronously with the left eye. The nodule was enucleated. No optic-nerve attachment could be found, nor was it present as a fibrous band.

Examination of the left eye. The left eye was normally developed. There was cicatricial ectropion of the lower lid. Vision was 6/12. Tension was normal. There was no congenital anomaly of the fundus.

Physical and laboratory examinations. There was no abnormality of the nervous system. All the systems seemed to be normally developed. No congenital anomaly was found.

Wassermann and Kahn reactions were negative. A biopsy showed most of the tissue of the anophthalmic right eye to be fibromuscular. A small piece resembling retina was present. The pigment epithelium of the retina could not be traced.

Family and past histories. The patient, an unmarried man, reported his father to be

* From the Department of Ophthalmology, Medical College of Agra, with the kind permission of Dr. R. S. Varma, professor of ophthalmology, and Dr. H. N. Bhatt, principal.

Fig. 1 (Agrawal and Adhulia). Unilateral anophthalmos.

healthy, with normal eyes. His mother had lost one eye in old age due to an inflammatory process, otherwise her eyes were normal. Brothers and sisters have normal eyes and are quite healthy. There is no history of an ocular anomaly in the family.

The patient had suffered from boils on the lids of the left eye which accounted for the ectropion of the lower lid and scar of the upper lid.

Theories of development of anophthalmos

1. *Atrophy.* Most cases must be regarded as showing extreme degrees of atrophy rather than actual absence. It has been experimentally possible to suppress the optic outgrowth as demonstrated by Ida Mann[1] In our previously reported case, it was noted that there was no trace of any sort of optic vesicle. This does not agree with the atrophy theory; there cannot be atrophy without some developmental being left behind.

2. *Amniotic band theory.* This theory admits failure of optic outgrowth but says it is due to pressure from an abnormally thickened amniotic band. This theory does not explain the development of the orbit, lids, and so forth which should also be absent. Experimental evidence is also against it.

3. *Failure of neuro-ectoderm.* Von Szily[2] pointed out that in this condition the single originating fault is a failure of the optic pit to deepen and form an optic outgrowth from the forebrain which occurs at the two-mm. stage in the human embryo. Experimental evidence strongly supports this view.

Attributing the etiology of this condition to the failure of the neuro-ectoderm should, at best, be regarded as unsettled.

Types of anophthalmos

There are three types of anophthalmos described in the literature. The origin and the embryonal history of these three types is quite distinct. The clinical picture is clear cut and affords easy classification.

1. Degenerative anophthalmos

Ida Mann points out that, in this condition, an optic vesicle develops normally in the beginning but subsequently degenerates and disappears completely. Usually there is great disparity in size between the two optic cups.

In these cases, a fibrous nodule containing pigmented tissue but no nervous tissue is found. Extrinsic muscles are found to be attached to this nodule. Very rarely, there is a fibrous band which runs from the mass to the optic foramen, representing a rudimentary optic nerve.

Normal development of the brain, including the chiasm and the intracranial portion of the nerve, is exceptional in the cases.

2. Primary

The eye develops from an optic outgrowth

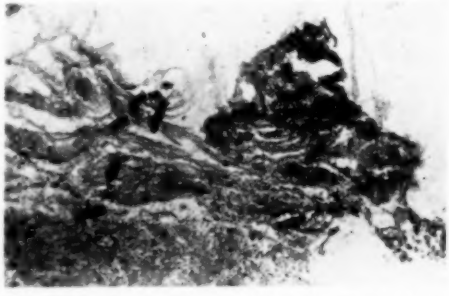

Fig. 2 (Agrawal and Adhulia). Photomicrograph, showing absence of pigmented layer in retina. (Hematoxylin-eosine, ×50.)

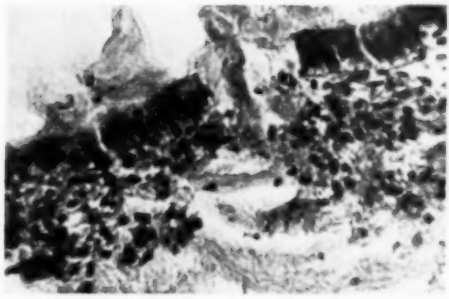

Fig. 3 (Agrawal and Adhulia). Photomicrograph, showing high-power view of Figure 2. (Hematoxylin-eosin, ×215.)

from the forebrain. It is the failure of deepening of optic cup which leads to the formation of anophthalmos. The error must develop at about the two-mm. stage, as it is at this stage that development of optic cup and rudiment of forebrain occurs.

In this type, the orbits are normally developed and the optic foramen is like a chink. It is the ectodermal elements alone which fail to develop.

The cornea and sclera form normally as condensations around the optic cup. Ida Mann, however, thinks that, even in the absence of neural elements, there is usually some attempt at mesodermal condensation.

Orbit, eyelids, conjunctival sac, lacrimal sac, and extrinsic ocular muscles with their nerve supply are all self-determining and as such develop normally. Sometimes there is a distortion in the lacrimal apparatus and other mesodermal elements of the eye, but complete absence of the uveal elements only has never been reported.

3. Secondary

There is a complete suppression or abnormality in the development of whole of the forebrain. It is only one of several abnormalities related to life and, as Ida Mann[1] rightly points out, is better known to a laboratory worker than to a clinician. The abnormalities are seen in monsters. Ida Mann points out that such an abnormality can be easily produced in amphibians. Klinkosch[3] and Rudolfi[4] have both reported rare unilateral abnormalities of this type.

Discussion

The case herein reported is rather peculiar in type:

It is unilateral, and the only unilateral anophthalmos cases described in the literature are those by Klinkosch[3] and Rudolfi.[4]

From the perusal of their cases it is gathered that both were secondary in type and were associated with gross abnormalities in the development of the brain.

In our case, however, no other congenital or developmental anomaly is present and, therefore, it cannot be considered to belong to the secondary group of anophthalmos.

It is rather difficult to state to which group our case actually does belong. It can be due to a failure in the deepening of optic cup on one side only, caused by some inflammatory cause and belong to the primary group. Cases in this group are classified as to the failure of ectodermal elements only.

Ida Mann has stated that there may also be distortion of lacrimal apparatus and mesodermal elements in addition.

Our case shows a development of the neuro-epithelium and the epithelium of the inner layer of the optic cup, showing only failure to develop beyond mesodermal condensation. Further, in this group, no case of unilateral anophthalmos has ever been recorded or reported, at least careful search of the literature revealed none; nor could a report of the lack of mesodermal differentiation be found.

If we consider this case to be a degenerative anophthalmos, there is no easy explanation. There has been a great disparity between the development of right and left optic cups. The extrinsic muscles were developed normally, so much so that, on exposure, the rudimentary nodule showed synchronous movements with the other eye. No rudiments of the optic nerve could be traced.

The peculiarity lies in the fact that, instead of a complete atrophy and absence of the

neural elements, as described in the literature, there was the presence of the elements derived from the inner layer of the optic cup, though in their embryonal forms. There was complete absence of the pigmentary uveal tract derived from the mesoderm. The mesodermal condensation in the form of fibromuscular bundle was present.

Section of the tissue puts the development of the mesoderm at about the 10-mm. stage. It is at this stage that the outer layer of the opitc cup produces pigment, which acts as a stimulus to the surrounding mesoderm to form the vascular part of choroid.

Due to some pathogenic cause, the development of the eye was arrested at this stage and so the stimulus to produce the choriocapillaris was lacking, leading to an undifferentiated mesoderm in that vicinity.

The primary change seems to be a complete degeneration of the outer layer of the optic cup due to some inflammatory cause, leading to an arrest of mesodermal development because of lack of stimulus.

In contradistinction to this the inner layer of the optic cup went on developing and differentiating to the 17-mm. stage. Due to lack of differentiation of the mesoderm and its retaining the primitive structure no stimulus was provided to the margin of the optic cup to elongate forward and, hence, no development of the iris or ciliary body occurred.

The entire development of the tunics of eye was arrested. Since the extraocular muscular condensations occur at the seven-mm. stage, they developed normally.

The cause of this unilateral arrest of development remains obscure, though we feel convinced that the primary defect in this case is the complete degeneration of the outer layer of the optic cup due to some inflammatory lesion in utero.

Medical College.

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FUCHS'S SPOT IN THE MACULA*

A rare lesion seen in myopic patients

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Ernst Fuchs described and illustrated the rare macular lesion seen in myopia which he called "the central black spot." The only microscopic examination of such a lesion which had been observed in life, that we could find, was made by Lehmus in 1875 at Zurich. Emphasis was placed upon the sharply circumscribed spot in the macula, its dark color, and the changes taking place as time went on.

It seems to be the general idea that these spots are flat; however, examination of the illustrations accompanying the Fuchs's article, together with his statement, "often it seems as though the black convex surface bore a kind of leaden sheen," proves that some of them were rounded projections.

The spot may be seen against an otherwise normal background but more often there are changes about it common to highly myopic eyes.

Lehmus reports a normal choroid and lamina vitrea, with swollen pigment epithelium heaped up to two thirds of the thickness of the normal choroid. Peripherally, the pigment was diminished or absent. Over the pigment mass was a gelatinous acellular exudate (fibrin remnants) of the same thickness as the pigment mass.

The appearance of the lesion and its later

* From the Department of Ophthalmology, Long Island College Hospital.

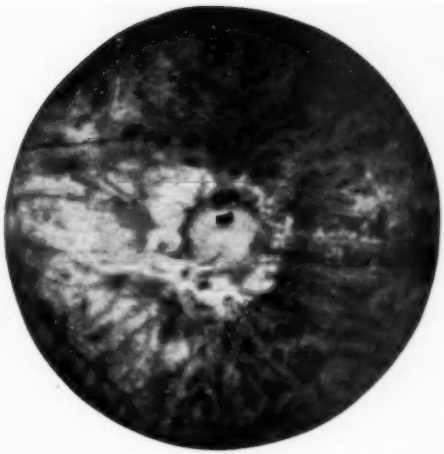


Fig. 1 (Aiello and Masters). Fuchs's spot in the macular area, O.S., is a grayish, spherical, solid mass arising from the choroid and pushing the retina forward.

behavior correspond to these microscopic findings; one should remember, however, that the picture will vary with the age of lesion.

The increase in the pigment explains the black spot; the exudate over the spot would lighten the color at the crest; the decrease in pigment around the defect would produce the lighter zone in this area. As the exudate shrinks and the pigmented mass degenerates, the gray or blue-white scar results. The lesion is rare but with modern binocular microscopes, one may find an elevation of a few diopters with an apparently lobulated surface.

The lesion is usually associated in the clinician's mind with hemorrhages and high myopia. Fuchs reported hemorrhages in only three of 11 fresh cases and myopia of three to 22 diopters. The ages of the patients ranged from 16 to 71 years; the average age of Fuchs's cases was 42 years.

Sudden metamorphopsia, the first complaint, is followed by a rapid decline in vision. Sooner or later both maculas are involved but the lesions in the two eyes may not be alike. The spot usually enlarges and finally becomes a flat dark area surrounded by a zone of tapetal atrophy.

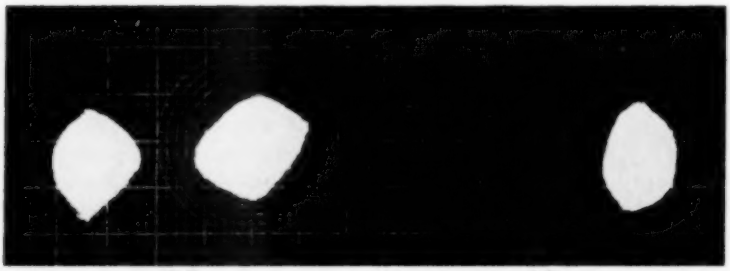
Case report

History. E. R., a man, aged 21 years, had worn glasses since the age of eight years. He had been in sight conservation classes until 13 years of age. He stated that his vision was 20/20 as a child. At the age of 14 years, while traveling with his parents in Puerto Rico, he noticed that poles seemed curved and soon a gray spot came before the left eye. He said that vision, except in this limited area, was good but we have no idea of how he arrived at this conclusion.

In 1949, at the Brooklyn Eye and Ear Hospital, he read 20/30, O.U., with a −10D. lens. The clinic card notes the presence of myopic changes. The next year, during routine examination at Brooklyn College, the appearance of the left eye so interested the examiner that the patient was referred to the Manhattan Eye and Ear Hospital for

O.S. O.D.

Fig. 2 (Aiello and Masters). Field study made on October 6, 1951, with a 0.6-mm. white test object, showing a central scotoma, O.S., due to a Fuchs's spot.



O.S. O.D.

Fig. 3 (Aiello and Masters). Field study made on January 15, 1952, with a 0.6-mm. white test object.

consultation as to the nature of the macular defect.

At the Manhattan Eye and Ear Hospital vision was recorded as 20/30 for the right eye and 20/100 for the left, with a −10D., O.U. He was seen in the surgical ward of the Long Island College Hospital (July 2, 1951,) because of poor vision of the left eye. All of the findings were normal except: O.D., 4/200, with a −10D., reads 20/25; O.S., 3/200 with a −10D., reads 20/200. Tonometric readings by the McLean instrument were: O.D., 24 mm. Hg; O.S., 26 mm. Hg.

The only deviation from normal of the right eye was circumpapillary atrophy, extending well toward the macula. The left eye showed an elevated circumscribed mass in the macula (fig. 1) two diopters high, about the size of the disc.

As observed through the binocular microscope, a solid mass arose from the choroid with the retina and its vessels over it. The mass was surrounded by a large area of tapetal atrophy with pigment disturbance. The peripheral fundus was tessellated, suggesting the early stage of choroidal atrophy.

There were no hemorrhages anywhere and the peripheral fields, taken with three- and one-mm. white test objects at 330 mm., were normal. There was a central scotoma before the left eye (fig. 2), using 0.6- and one-mm. white test objects at 190 mm. Six months later this defect (fig. 3) was mapped under the same conditions and no change was found. Cyst of the macula, tuberculoma, an organizing mass after hemorrhage between the lamina vitrea and the pigment layer, and choroidal neoplasma and metastasis were considered as diagnostic possibilities before the diagnosis of a Fuchs's spot in the earlier stages was arrived at. The lesion has been under observation for more than a year with no change apparent.

340 Henry Street.

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Fig. 1 (Abrahamson and Cohien). A view showing the arrow in the orbit.

Fig. 2 (Abrahamson and Cohien). Patient's final appearance; vision, 20/20.

ARROW IN ORBIT

A CASE REPORT

IRA A. ABRAHAMSON, JR., M.D., AND DONALD M. COHIEN, M.D.
Cincinnati, Ohio

While unusual accidents to the eye and adnexa are rather common in this mechanical age, the occurrence of an unusual type of accident resulting in a penetrating injury of the orbit by an arrow, was thought worth recording.

A search of the literature revealed only three other cases of this type of injury; two reported by Moncreiff and Scheribel,[1] and one reported by Hofmeister.[2] Neither article was illustrated by photographs.

CASE REPORT

A white boy, aged 11 years, was shooting a bow and arrow with a friend. While trying to catch the arrows his companion was shooting, one accidentally lodged into the left orbit (fig. 1).

The arrow, which was steel tipped, evidently struck with great force entering the lower lid and cul-de-sac, being deflected by the eyeball and penetrating the orbit to the extent of three cm. or more. During its course, it split the conjunctiva, Tenon's capsule, and the inferior rectus muscle, elevating the eyeball and producing marked diplopia. While piercing the orbit, it fortunately missed the optic nerve, which projects posterior and nasally between its protective sheath, orbital fat, and the muscle cone.

Under general anesthesia, the arrow was gently withdrawn and the wound cleansed. Considerable hemorrhage occurred subconjunctivally after the withdrawal of the arrow, ballooning out the lower cul-de-sac. The hemorrhage was stopped and the lacerations of the lid and cul-de-sac were sutured.

Tetanus toxoid was administered, together with a course of antibiotics. The patient made an uneventful recovery. At the end of three weeks, the hemorrhage had completely absorbed and the diplopia, which, at first, was annoying, disappeared. He received a nice cosmetic result (fig. 2) and 20/20 vision in that eye.

808 North Crescent Avenue (29).

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AN IMPROVED APPARATUS FOR SCOTOMETRY*

J. P. FRANCIS LLOYD, F.R.C.S., A. C. L. HOULTON, M.A., AND VICTOR PURVIS, M.B.
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Since the rebuilding of the Oxford Eye Hospital a projection scotometer has been installed which may prove of interest to others engaged in routine scotometry.

The apparatus consists of a two-meter, 25-degree gray screen, the target spot having been provided with a standard Juler projection scotometer by C. Davis Keeler. Two new additions believed to be more or less original have been added: (1) Variable lighting for controlling the general brilliance of the screen; (2) a projector for illuminating the fixation spot.

The target projector projects various sizes of target from 1.0 to 30 mm. of white, red, or green color. Considerable experimental work was carried out with different general illumination of the light-proof room, and finally a rheostat was made giving six different low levels of illumination and alternatively full room light. The latter is intended for use with a normal black screen for teaching, or any other purpose.

The rheostat has been marked and it has been found that one setting of the rheostat will suffice for most examinations. This setting is recorded for future reference.

By lowering the general illumination (particularly when undertaking color scotomas), some scotoma records have been obtained which were difficult or almost impossible to obtain by black-screen methods. It was the desire for lower general illumination that made the illumination of the fixation spot necessary.

The usual small button (which in any case was not very stimulating for accurate fixation) has been discarded and replaced by a circular white disc approximately 1.5-degree diameter, having a fine cross ruled on it as suggested by Traquair.

The fixation light is projected upon this disc, the size being variable for color (red, green, or white), size (5, 15, 25, 50 mm., approximately), and variable in intensity in four steps. The use of a spot with a color different from that of the target completely removes any confusion on the part of the patient as to where he has to look, and simplifies the operation instructions.

Normally the smallest fixation spot is used that is found to be suitable for the visual acuity of the patient. The variable illumination of the fixation spot has proved a useful refinement in cases in which a large spot is necessary but is otherwise too conspicuous in contrast with the scotometer target.

The size, color, and intensity of the fixation spot is varied by rotating selector discs incorporated in the projector, giving quick and easy adjustment. The fixation projector has proved invaluable with patients of low visual acuity.

Most patients remark upon the ease with which they are able to carry out the test as compared with the black screen and wand, and they find it less fatiguing. The procedure is as simple as it is speedy, and certainly more accurate for there is no wand to distract the patient's attention.

The projection scotometer is held in the hand, along with the record charts which are marked direct, eliminating the use of pins and subsequent transcribing.

The target illumination may be cut out at

* From the Eye Hospital.

will to make sure the patient is alert, and a subjective check on fixation may quickly be made by directing the target on the blind-spot position.

Few difficulties have been experienced in fixation, and with those patients for whom a satisfactory result has not been obtained a further check on the black screen has also proved a failure.

The variable illumination of the screen and the fixation-spot projector was suggested and developed by the senior optician of the Oxford Eye Hospital (Mr. E. W. Allen, F.S.M.C. Hon.) after some months of experimental work in conjunction with us. The apparatus has now been in constant use for over six months, and has proved most satisfactory.

Walton Street.

LEONTIASIS OSSEA INVOLVING THE ORBIT*

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University Heights, Ohio
AND
BENJAMIN E. ROBINSON, M.D.

Leontiasis ossea (fibromatosis osteoplastia ossium, hyperostosis of the skull, megalocephaly, hyperostose due os de le tete),[1-3] a rare disease first described by Malpighi in 1697, has seldom been reported in the ophthalmic literature.

The chief feature of the disease, hyperostosis, usually involves one or all of the bones of the skull.[1] There is periosteal and endosteal hyperplasia in the affected areas which brings about sclerosis of the spongiosa and causes marked thickening of the bone.[2] The symptoms are a result of pressure on vascular and nervous tissues and vary with the particular bone or bones involved.

The disease may become an ophthalmic problem because it can produce changes in the bony orbit, exophthalmos, and optic atrophy, resulting in field changes, decrease in visual acuity, and limitation of ocular motility.

Fig. 1 (Alexander and Robinson). A bulging mass over the left eye occupied the frontal area.

CASE REPORT

An 18-year-old Negro was referred to the ophthalmologic service at the Sampson Air Force Base Hospital, Geneva, New York, for evaluation of displacement of the left orbit.

Physical examination revealed:

Vision: O.D. 20/20; O.S., 20/60.

External appearance (fig. 1). A bulging mass over the left eye occupied the left frontal area. The mass was not connected to the overlying tissue. By palpation it felt like a hard bony structure fused to the skull bones.

The mass measured in its greatest height 70 mm. and its greatest width 72.5 mm. and appeared to displace the left orbit and contents downward 10 mm., and forward as shown in Figure 2. Palpation of the orbital fissure revealed an apparently shallow orbit.

The forward displacement resulted in unilateral exophthalmos; Hertels' exophthalmometer reading: Base 110; right eye, 19

* From the Eye Section, Sampson Air Force Base Hospital, Geneva, New York, Col. John R. Copenhaver, commanding officer.

Fig. 2 (Alexander and Robinson). Note the prominence of the left eye and forehead.

mm.; left eye, 23 mm. Even with this displacement there was full movement of the left eyeball in all fields of gaze.

The other positive ophthalmic finding was revealed on fundus examination. The right disc was of good color and contour. The left disc revealed optic atrophy, manifested by pallor in all quadrants and by prominent margins. The changes in the disc were substantiated by the perimetric and central field studies. These revealed peripheral contraction of the fields for 1/330 blue and an enlarged blindspot in the left eye (1/1,000 white).

In view of the orbital changes, a general physical examination was made by the Section of Internal Medicine. This was reported as being essentially normal in all respects.

Laboratory studies, including serum proteins, blood calcium, phosphorus and phosphatase were all within normal limits. The blood serology was negative.

The positive findings reported by the Department of X-ray were:

"There is massive proliferation of the inner table of the frontal bone on the left. There is also bony prominence extending back along the greater wing of the sphenoid. There is flattening of the left superior orbit. There is no associated bone destruction or increased vascularity. The antrum on the left is displaced inferiorly. The zygoma on the left is obscured. A film of the left orbit shows it to be small. Films of the long bones and pelvis appear normal.

"An attempt was made to visualize the optic foramen. This was indeed difficult because of the patient's pathology. The right

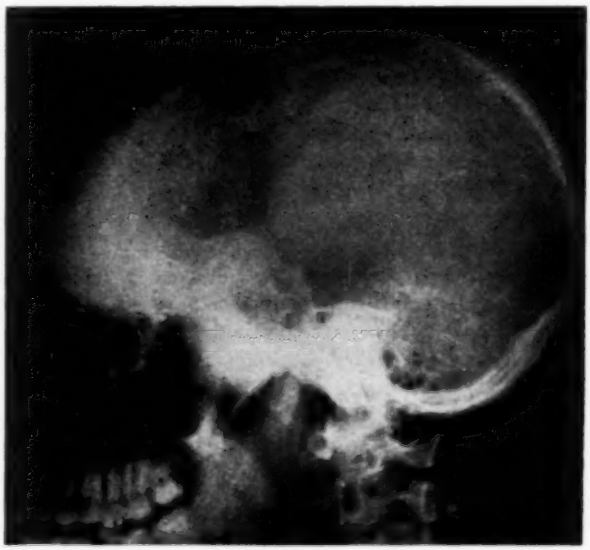

Fig. 3 (Alexander and Robinson). An X-ray view of the bone changes in leontiasis ossea of the frontal and sphenoid bone.

side is normal. The left side is definitely small when compared to the right. The right foramen measures 4.0 by 5.0 mm. and is oval. The left measures 3.0 by 4.0 mm. and is tear-shaped, therefore, the apex of the foramen is even smaller than the measurements would indicate."

Figure 3 shows a left lateral X-ray view of the skull. Here is seen the marked thickening of the involved frontal and sphenoid bone.

In view of these findings the past medical history of the patient was obtained. He was seen at the Brooklyn Eye and Ear Hospital on June 16, 1947, and the pertinent findings were reported as: *History.* Left side of face and left eye protruding forward, since childhood. *X-ray.* Marked sclerosis and thickening of the left frontal bone and base of the skull in its anterior half, including the left sphenoid. *Examination of eyes.* O.D., 20/20+3; O.S. 20/40−3. O.D., normal blindspot, no scotomas. O.S., blindspot enlarged superiorly and extending to within three degrees of fixation.

The patient was seen at the Jewish Hospital, Brooklyn, in December, 1949. The X-ray findings were reported to reveal "tremendous thickening" of the floor of the left frontal bone, and the left sphenoid wing and the anterior portion of the body of the sphenoid. The left optic foramen was reported as slightly distorted but could not be well visualized because of the marked density of the left orbit. Examination of the pelvis, the lower extremities, the forearms, and the hands at that time failed to reveal any evidence of bony disease.

The patient was followed in the Jewish Hospital Eye Clinic and the following was reported: *Vision.* O.D., 20/20; O.S., 20/40. Left eye showed exophthalmos and early pallor of the optic disc. Visual fields showed peripheral contraction of the left eye.

In view of these findings, our consulting radiologist felt that there had been progression of the disease, although slight, over the years.

A review of the ophthalmic literature published in the United States in the past decade revealed one similar case, reported to the Denver Ophthalmological Society by Reynolds,[4] with changes of the sphenoid bone of the right side producing symptoms of proptosis of the eye, limitation of movements, and reduced vision. It was of interest to note that in the literature on unilateral exophthalmos previous authors have not considered leontiasis ossea as an etiologic cause.

Summary

1. An 18-year-old Negro was presented on whom was made the clinical diagnosis of leontiasis ossea.

2. The pertinent ophthalmic findings at that time were:

a. Displacement of the orbit downward
b. Exophthalmos
c. Optic atrophy
d. Decreased visual acuity

3. X-ray findings were consistent with the diagnosis of leontiasis ossea.

4. From observation of the patient's past medical history, the disease was shown to be progressive.

East Carroll Boulevard (18).

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PIG EYES FOR INSTRUCTION AND PRACTICE*

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Pig eyes have long been used for instruction in the anatomy and surgery of the eye. They are especially valuable for occasional ophthalmic operators, for ophthalmologists living in outlying sections who must train their operative help locally, and in the Armed Forces where changes in officer and enlisted surgical assistants occur with frequency.

If the similarity of the pig eye to the human eye is recognized as being only a gross one and the disparity in thickness and toughness as being great, many benefits can be obtained from its use.

The obtainability of pig eyes in quantity is a great advantage, but their tendency to spoil even when refrigerated has until now been a considerable disadvantage. Since hog slaughtering is seasonal in all except large communities, a plan was established to measure the keeping qualities of pig eyes under varying circumstances in the tropics.

With simple refrigeration the eyes spoiled in less than one week. Formalin was tried in 10-percent strength and was found to harden the eyes unduly. As a result of various trials, the following procedure was found to be successful:

1. Removal of the eyes from the pigs by clean and nontraumatizing methods.
2. Immersion in alchohol (70 percent) immediately upon removal from the pig.
3. Storage in saline solution to which was added 5.0 cc. of 10-percent formalin for each 200 cc. of physiologic saline.
4. Refrigeration.

When thus preserved, pig eyes were found to be satisfactory for surgical and dissection purposes after three months of keeping.

For enucleation of the eyes, a heavy, long handled, short-bladed scissors and a heavy, toothed forceps are required. The lateral canthus is divided, the external rectus muscle is grasped firmly and close to the globe with the heavy forceps, and the eye is drawn outward while the heavy scissors divide the muscles successively to permit removal.

While still holding the eye in the original grip of the forceps, it is agitated in the 70-percent alcohol solution for a matter of moments to remove hair and detritus and is then placed into a jar containing the formalin and physiologic saline.

If two or more eyes are placed in individual, small, covered ointment jars, they can then be used in sequence without the entire stored supply being subjected to the ingress of bacterial flora.

In the actual use of these eyes, it should be understood and repeatedly explained to the student that the toughness of the pig eye greatly exceeds that of the human.

Cutting edge heavy needles and coarse instruments should be used. For incision, the edge of a safety razor blade broken off and held in the jaws of a small hemostat is useful. In general, an intracapsular cataract extraction cannot be simulated because of the tenacity of the zonules, so an anterior capsulotomy must be performed to allow an extracapsular extraction. However, in eyes which have been preserved by the above technique for more than two months, it was found that the lens had become sufficiently hardened to allow intracapsular extraction in an appreciable number of cases.

It is suggested that the ophthalmologist perform two or three procedures alone with the pig eye before using it for instruction purposes. Thus he would recall to his own mind the great difference that characterizes it from the human eye before beginning his teaching.

By injecting water subconjunctivally it is possible to raise a conjunctival flap for instruction in intraocular operations but one should not attempt to dissect this all the way to the limbus. By stopping approximately two

* From the U. S. Naval Hospital, Guantanamo Bay, Cuba. The ideas and opinions expressed in this communication are those of the author and do not necessarily represent the views of the Navy Department.

mm. short of the limbus, the flap can be retained intact and the exaggerated thickness of the scleral coat can be utilized to allow sufficient obliquity in the incision to enter the anterior chamber from that distance.

One day before use, any set of eyes should be checked in the refrigerator. If too soft, they may be placed in plain water overnight, and if too hard, two or three pinches of table salt can be added and the consistency will usually be found to be satisfactory. Freezing is to be avoided.

Although interest in pig-eye surgery may diminish since it is no longer used in the examinations of the American Board of Ophthalmology, its value for basic instruction purposes continues to be great.

1135 D Street.

Ophthalmic Miniature

Some people, without any previous indisposition, and who never applied close, either to reading, or work, are subject to Cataracts. These people, are generally of a cold constitution, and the blood moves slow: in consequence of this, the eye has not that usual briskness, observed in people of a warmer constitution, and this coldness contracts the external Laminæ of the Chrystalin.

But we will confirm this Theory, by more familiar experiments—observe but a person, who, upon plentiful blood-letting begins to faint, he grows pale, his eyes lose their transparency, objects appear green, they then scatter, the Chrystalin thro' the Pupilla, seems greenish; he loses his sight, and his senses seem absorbed.

Here the external Laminæ of the Chrystalin seem a little to collapse, thro' the slowness of circulation; but as the cause does not continue, he soon recovers the usual briskness of them.

Being with the late Sir Peter Warren, at the Siege of Cape-Breton, he was one very cold night, ordered upon some Expedition, from his Ship. He was away about two hours, and on his return, was preparing for bed; but found his sight scatter, and in a few minutes became perfectly blind. He immediately got a good fire, and some hot punch, which after drinking some glasses, animated him a good deal, and he insensibly recovered his sight. This story he told me the following winter; but with these additional circumstances, that he was subject at times, and particularly in cold weather to an impediment in his sight, and it seemed to him, as if Hairs were swimming in the air—this complaint I effectually removed, by means of an Ophthalmick Spirit; and he has had, no return of that complaint since, as he assured me about a Twelvemonth ago.

Mr. O'Halloran of Limerick,
A critical analysis of the new operation for a cataract, 1750.

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

SECTION ON OPHTHALMOLOGY

October 23, 1952

DR. GEORGE F. J. KELLY, *Chairman*

ORBITAL IMPLANT

DR. WILFRED E. FRY described an orbital implant with additional material at the upper pole. He said that this is not an implant to end all implants. It is one to be added to the long list of others. The extent of its usefulness is yet to be determined.

It has one feature of interest. A small amount of material had been added to the upper pole of an implant that has been used at various times beginning about six or eight years ago. The purpose of this is to make it easier for a prosthesis to be fitted so that the appearance of the upper lid is more acceptable.

It is fully covered by Tenon's capsule and by conjunctiva. The amount of rotation is not noteworthy. This amount will vary with the skill of the fitting of the prosthesis and with the care of the surgery.

The implant is based on a 16-mm. plastic sphere. The anterior face has been cut off to give a flat front surface. At the superior pole a two-mm. addition has been made. This is blended in with the curve of the sphere.

Four oblique tunnels are drilled through the sphere. These tunnels are three mm. in diameter and meet on the anterior surface. All edges are rounded slightly and made smooth.

The size may be varied by using an 18-mm. sphere or a 14-mm. sphere. The 16-mm. sphere size is the most useful. The 18-mm. sphere is the largest that has been found useful.

Several points are suggested for the surgery:

Care should be used in overlapping the muscles, using silk on one and catgut on the other of the two opposing muscles.

A deep anchor suture should be used at the inner and outer ends of the conjunctiva. This helps deepen the sac at these points.

Tenon's capsule and the conjunctiva should be sutured horizontally but at slightly different levels.

The first prosthesis can be fitted in two weeks.

I have not searched the literature as to how many similar implants have been devised. I may be merely making a restatement of something used 50 years ago.

USE OF NEWER ANESTHETIC DRUGS

DR. HRANT H. STONE made the following general observations concerning ophthalmic surgery:

1. Elective surgery almost 100 percent.
2. The average patient is an elderly patient. Therefore, complicating diseases are frequent.
3. Surgery is performed on a very important organ.
4. Many ophthalmic surgeons become so engrossed in the eye and its pathology that the remainder of the patient is forgotten.
5. Operative field is extremely small and crowded. Proximity of the eye to the respiratory passages makes maintenance of the airway difficult when using general anesthesia.
6. Almost all ophthalmic surgery could be performed under local anesthesia, if necessary.

Local anesthesia is so successful in ophthalmic surgery because, being a superficial organ, both the sensory and motor nerves to the eye are easily accessible. The advantages of local anesthesia for ophthalmic surgery were enumerated. Factors instrumental in the success of local anesthesia were discussed. Proper premedication (especially with barbiturates), knowledge of anatomy,

techniques of local anesthesia, and pharmacology of local anesthetic drugs were some of the points discussed.

The use of morphine in ophthalmic surgery was considered. It is a valuable drug. It was pointed out that nausea and vomiting associated with its use did not represent morphine sensitivity. Nausea and vomiting were more frequent in the ambulatory patient, more frequent when large and multiple doses were employed, and more frequent when food was present in the stomach. These findings also apply to the morphine substitutes such as Methadon, Dilaudid, and Demerol.

An evaluation of the currently used local anesthetic agents for topical infiltration and regional anesthesia was made. Various adjuncts to local anesthesia, such as vasopressor drugs, hyaluronidase, and curare were discussed and evaluated. The disadvantages and limitations of local anesthesia for ophthalmic surgery were mentioned.

The use of general anesthesia for ophthalmic surgery was next considered. Among the factors stressed were the importance of preoperative medication, the advantages and disadvantages of the various anesthetic agents employed, and the adjuncts of advantage when using general anesthesia.

General anesthesia is only as safe as the skill of the administrator. The selected agents, whether they be inhalation, intravenous, or rectal drugs, are not of primary importance if a competent anesthetist is employing them. General anesthesia can be used far more extensively for ophthalmic surgery since the advent of the professional anesthetist and the newer improvements in technique.

General anesthesia should not be denied the ophthalmic patient if an indication exists for its use. Such an indication usually depends upon two factors. (1) The choice of the surgeon, and (2) the coöperativeness of the patient.

Unless specifically contraindicated, general anesthesia for ophthalmic surgery should always be administered through an endotracheal catheter. Only in this manner can the two primary dangers of general anesthesia—respiratory obstruction and respiratory depression—be effectively combatted.

The use of pentothal sodium was discussed in detail. The conclusion was made that it is an excellent agent when used with care. The complications associated with its use—laryngospasm and respiratory depression—can be overcome by using an endotracheal tube.

Discussion. Dr. Edmund B. Spaeth, in discussing the paper, stressed the following points:

A. Absolute dependency upon the anesthetist is most important.

B. The importance of preoperative preparation. Most mistakes and accidents in ophthalmic surgery connected with anesthesia are the result of poor preoperative preparation—too much routine and not sufficient individual consideration of each patient.

C. Careful choice as to general or local anesthesia. In long and extensive procedures, such as retinal separation surgery, plastic surgery, lacrimal-sac surgery, and similar procedures, the surgeon should not be pushed for time. Ask the anesthetist to check such cases and utilize his expert knowledge.

D. There is no doubt that hyaluronidase is most important in proper local anesthesia.

E. There are so many factors connected with muscle surgery of importance at the time of the surgery that general anesthesia is practically necessary in all cases except the very occasional.

Dr. George F. J. Kelly: I would like to ask Dr. Stone what are the danger signs in the use of sodium pentothal intravenously? The texts on pharmacology are not too clear on this, and state that one has to depend on the experience of the anesthetist. Also, Dr. Stone, which would be your choice of anesthesia if you had to have ophthalmic surgery performed on yourself?

Dr. Stone: Respiratory depression and apnea are the primary dangers when using

sodium pentothal. Respiratory depression is not of serious consequence to the experienced anesthetist. It is possible to oxygenate a patient perfectly and to remove carbon dioxide by artificial respiration in an apneic patient while still maintaining a stable blood pressure. This can only be done, however, if the anesthetist has complete control of the patient's airway by the use of an endotracheal tube and also if the apparatus is available by which manual inflation of the lungs with oxygen can be achieved.

It is felt that the use of sodium pentothal for ophthalmic surgery, especially cataract surgery, is safe if these requirements are met. During cataract surgery, it is vital to have a quiet patient. Straining, coughing, sneezing must not occur. The use of doses of sodium pentothal which depress respiration and prevent such complications is justified in the hands of the qualified anesthetist.

Laryngospasm is the other real danger when using sodium pentothal. Its development can be fatal. Laryngospasm usually occurs under light pentothal narcosis, and can be prevented or minimized if larger doses of the drug are employed prior to the initiation of stimuli which can evoke such a reflex. Laryngospasm can be prevented by the use of an endotracheal tube. It is felt that the use of an endotracheal tube is vital for the safe conduct of any ophthalmic procedure especially an intraocular one, when using general anesthesia with sodium pentothal.

If a cataract extraction was necessary for myself, I perhaps would prefer local anesthesia; however, I would not hesitate having general anesthesia with sodium pentothal if I knew the qualifications of the anesthetist and felt that an indication existed for its choice.

Monocular aphakia

Dr. Alfred Cowan: On removal of the crystalline lens an entirely new kind of vision is provided; probably as acute or more so than before but with magnified images, no accommodation, greater aberration, lessened focal depth, a changed pupil which allows a different quantity and quality of light to enter the eye.

It is so different that it cannot possibly be paired up with a normal dynamic eye to make a workable team, whether it is corrected with a spectacle lens, contact lens, or a minifying lens.

Many claims have been made that good binocular single vision, from infinity to 10 inches in all ages, even in very young persons with good accommodation in the phakic eye, has been obtained for monocular aphakics by the use of a contact lens; that then the retinal image is the same size or nearly the same size as that in the other, the normal eye.

Mere absence of diplopia does not indicate single binocular vision. If careful examination is made in these cases, it will be found that there is at best a spurious kind of binocular vision—nothing more than that the patient has learned to disregard entirely the image of one or other eye. A one-eyed person is not necessarily unhappy and not terribly handicapped. He may do well in most occupations and in many sports. A one-eyed person can have a considerable sense of depth and solidity and judgment of distance. For direct vision one eye is just as good as two.

Of course, two eyes with good comfortable single binocular vision are better than one. Stereopsis is an advantage, and it would be worth a good deal of trouble to acquire it, but in my opinion if the patient has one useful eye, whether aphakic or normal, he should not be subjected to the hazard, apprehension, nervousness, and cost of an operation, then the business of the fitting of a contact lens, besides spectacles and after that, a course of training, all in order to obtain, at best, a counterfeit sort of single binocular vision.

Discussion. Dr. M. Luther Kauffman: I am sure we are all disappointed. I hoped that Dr. Cowan might present a method of obtaining satisfactory binocular function for

these patients. However, this would be a great deal to expect since the fundamental principles of optics remain the same as in the past.

It remains our responsibility to do all we can to prevent this condition of monocular aphakia, when the other eye has satisfactory visual functions, and to be able to explain to the patients what the difficulties are in those cases in which there is no choice in the matter. The too early removal of certain cataracts from one eye while the other retains good vision often causes more difficulty than benefit in the patient.

Dr. Paul A. Rockwell: The subject of contact lenses in uniocular aphakia has not been well studied in the literature. Most of the published large series have relied upon postcard inquiries, and have lacked careful objective evaluation. Because of this, the Graduate Hospital group is engaged in a program to study this problem as thoroughly as possible.

We have about 50 cases which are being examined by screen testing, the Maddox rod, the synoptophore, and the stereoscope. This work is still in progress, so I will not give any figures; however, at this stage we can confidently say that the use of a contact lens in these cases is a practicable and valuable procedure.

The majority of the patients demonstrate simultaneous macular perception, and some have a fair degree of stereoscopic vision. Whether this is foveal or peripheral, we are not prepared to say. We have had very few patients who are unable or unwilling to wear a contact lens, and we attribute this to the fact that we are using the Lacrilens. We think this lens is far superior to any of its predecessors.

Dr. Alfred Cowan: I believe that if a patient has one eye with useful vision, both he and the ophthalmologist should be satisfied. If the ophthalmologist sees fit and the patient can use it, a contact lens is a very good means for the correction of aphakia; but it will not enable a person with monocular aphakia to obtain good, comfortable, binocular single vision.

Dr. Rockwell said that in his study of a series of aphakics the accommodation was not given serious consideration, because the subjects were all over 40 years of age. I think a power of 2.5D. of accommodation is a serious consideration. No person could possibly be comfortable with this much difference between the two eyes.

M. Luther Kauffman,
Clerk.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

May 5, 1952

Dr. Adolph Posner, *president*

Recent developments in the field of color vision

Dr. Joseph I. Pascal presented a paper on this subject during the instruction period.

Preparation and maintenance of sterile ophthalmic solutions

Dr. Frederick H. Theodore presented a paper on this subject. The complete manuscript was published in the May, 1952, issue (**35**:656, 1952) of The American Journal of Ophthalmology.

Discussion. Dr. Adolph Posner asked if pharmacists are actually prepared to observe sterile precautions. He also asked, how long do solutions prepared under sterile conditions remain sterile while in use?

Dr. Kimbrig mentioned the fact that the Winthrop Company claims that their pontocaine solution is self-sterilizing.

Dr. Theodore said that he has overcome the problem of contamination by another method. He said that he uses vials containing only 1.5 cc. of solution, and when this amount is finished he sterilizes the vial again.

Dr. Kleefeld mentioned the use of solutions which are put up in sealed ampules, which the patient breaks open when he is

ready to use the medication. These individual ampules each contain one dose. This is the only method which insures a truly sterile solution. Dr. Kleefeld said that in his office he uses applicators rather than droppers. The applicators are used only once and then discarded.

Dr. Medine said that Burroughs Wellcome used to have small wafers for all types of eye preparations, and he raised the question of whether these were sterile.

Dr. Theodore replied that these tablets are fairly sterile. To Dr. Posner, Dr. Theodore said that Mr. Feinstein reports that all pharmacists in the last 10 years have had sufficient training to prepare sterile solutions. The procedures are very simple.

A solution prepared sterilely will remain sterile for about two months if left open. The solution may be dusty but is still sterile. In the case of a fluoresein solution, it was prepared with merthiolate and chlorbutanol and was then inoculated with pseudomonas. After 48 hours this solution was found to be sterile.

To Dr. Kimbrig, he said that holocaine is self-sterilizing. Pontocaine can carry viruses of epidemic keratoconjunctivitis. Winthrop adds chlorbutanol and boric acid to their pontocaine solution.

Dr. Theodore said that the ampules mentioned by Dr. Kleefeld were those made in France by Klein. Dr. Theodore said that these were very expensive and that the heat used in their manufacture destroys alkaloids. To Dr. Medine, he said that he believes that Burroughs Wellcome still makes the wafers for eye solutions.

Lamellar resection of sclera for detachment of the retina

Dr. Milton L. Berliner said that the purpose of this preliminary report was to draw the attention of American ophthalmic surgeons to the procedure of lamellar resection of the sclera which consists of the removal of tangential strips of three fourths of the scleral thickness in conjunction with diathermy coagulation. The sclera is shortened by means of buried silk sutures which causes an infolding of the surgically thinned area. The operation is simple to perform and does not expose the globe to any of the dire complications attending penetrating scleral resections.

Lindner endeavored to shorten the eyeball by infolding a "surgically thinned" sclera but abandoned it because the sclera unfolded and the sutures absorbed. Evidently, he employed catgut sutures instead of silk. At the last meeting of the International Congress of Ophthalmology, London, 1950, Weve presented a paper in which he recommended "reefing" of the sclera by means of a strong and durable material called "supermit" without resecting any of its layers.

In Lyons last summer (1951), Professor Paufique discussed with me the feasibility of lamellar resection of the sclera in association with diathermy coagulation. He said that Shapland of London had also proposed this kind of operation. As has often happened in medicine, it is not unusual for several workers in different parts of the world simultaneously to hit on the same idea.

Originally, Paufique performed the resection without diathermy coagulation but the results were not favorable. This spring, his magnificent paper on "The place of scleral resection in the treatment of detachment of the retina" which included personal technique, indications, and results, appeared in the *Annales d'Oculistique*. On my return from abroad last autumn, I began to employ this type of operation.

Nowadays in the so-called good cases, we may expect from 70 to 90 percent cures by means of the classic diathermy procedure. Using lamellar resection, Paufique had 60-percent success in so-called "bad" cases; that is, cases in which the classic operation would undoubtedly have failed. He performed 66 operations in 57 eyes. In a small series of 14 "bad" cases we have had seven cures or about 50 percent.

My first experiences were on five hopeless

eyes in which the detachments were total and had existed over two years. Nevertheless, I was encouraged when in one of these desperate cases (the fourth), after the second part of the circumference of the eye was subjected to a scleral resection, the patient had obtained a slight improvement in vision. Where formerly he had faulty perception to light, he now had the ability to count fingers at two feet. Here the cure was partially an anatomic one and no great improvement in vision or functions could be expected considering the age of the detachment.

Dr. Berliner said that he then proceeded to employ the operation as a primary procedure in so-called "bad" eyes and so far five cures have been obtained. Two of these cases were in aphakic eyes where no tears were found.

The third was a case of secondary glaucoma following a low-grade uveitis. The pressure in this eye had been normalized by two previous operations. Two years later a detachment of the nasal half of the retina occurred. The pupil was rigid and it was not possible to find any tears ophthalmoscopically.

The fourth case occurred in a highly myopic eye with a large disinsertion below. The fifth occurred in a nine-year-old boy following a perforating injury to the cornea. Except for the upper quadrant, the retina was entirely detached. Below, the retina was thrown into folds and, at the 6-o'clock position. Several small cystic-appearing dehiscences suspected of being holes were seen.

Indications. Indications for lamellar scleral resection is in cases which have shrinking and retraction of the retinal-vitreous substance, especially when the retina has become fragile. In such cases the classic diathermy operation may result in new tears and in more complete retinal separation.

As stated by Lindner, the principle of scleral shortening lies in the attempt to adapt the sclera and the choroid to a displaced, shrunken, and shortened retina. Shrinking and shortening of the retina occur in cases of detachment of long standing, or of recent detachment which are due to organization on the anterior retinal surface.

In a number of cases in which the detachment was originally caused by one or more tears which seem to have been closed by previous diathermy, a certain degree of detachment persists or develops without visible formation of new tears. In other cases tears are reopened by local shrinking of the retina secondary to the formation of so-called "star-shaped folds."

In some cases, the persistence of a detachment is due to organization of a large hemorrhage in the corpus vitreous. Here, too, only shortening of the sclera may preserve some function of the eye.

These are the cases in which preoperational binocular bandaging and bedrest for several days produce no objective or subjective improvement.

Dr. Berliner said that, in his opinion, in these so-called "bad" cases, lamellar scleral resection should be done as a primary procedure. Cases of detachment in high-grade myopia with giant tears or disinsertion are considered poor subjects for the classical diathermy-coagulation operation.

In aphakic eyes, with the well-known bad prognostic course following the usual operation, Dr. Berliner said that he prefers the lamellar scleral resection as a primary operation even when one or more tears can be found. In many of these cases, the pupil may be rigid, or following extracapsular operations, lenticular remains may interfere with good visualization of the fundus periphery.

The operation is also useful in detachments which occur as a result of arteriosclerosis of the retinal vessels, in which the retina is very fragile and numerous elongated dehiscences are found in widespread areas. Ordinarily, such cases and similar ones due to other causes require extensive treatment and even several interventions, with the frequent result that the retina becomes attached in one spot and contracts and produces tears in other areas, especially

along the margin of the treated areas.

With lamellar scleral resections, the diathermy treatment used is of a much milder type than that employed in the usual operation and, consequently, more extensive areas can be treated without danger. Lamellar scleral resection is recommended in cases where detachment of the retina occurs with cataractous lens changes which preclude accurate viewing of the fundus.

As a secondary operation, in instances where relapses occur following the classic procedure, lamellar scleral resection can be done but with greater difficulty. Although possible, it is admittedly more arduous to perform a lamellar scleral resection in an area already thinned out by previous coagulations. Perhaps reefing (Weve) combined with diathermy when approaching such areas may offer an easier solution. The aim of this operation, just as in the classic diathermy coagulation procedure, is the closure of the tears, a dictum insisted upon by Gonin.

Technique. The length of the scleral strip excised should not be less than a third of the globe's circumference; in most cases, Dr. Berliner said, he had to remove almost half of the circumference. This frequently can be done with the severing of one of the tendons of the recti. The conjunctiva and Tenon's capsule are dissected freely over the operative areas.

With the scleral field exposed, the strip to be removed may be outlined with a toothpick dipped in gentian-violet solution. With experience, this may be superfluous. This strip is then outlined with a Lundsgaard knife and from about one third to one half of the scleral thickness is incised. The anterior edge of the strip is ordinarily placed about two to three mm. behind the muscle insertion especially when no tears are found. In other cases, depending on the location of the tears it may be placed nearer the equator. However, the vortex veins should be carefully avoided. The width of the strip should be from three to four mm.

It is easier to begin the dissection by making a cut across the center of the outlined strip. Then carefully deepen this cut to about two thirds of the scleral thickness. When doing this, one is guided by the darker appearance of the depth of the incised sclera, as the lamina fusca is approached. Then grasp one of the edges (Hess iris forceps or scleral forceps of St. Martin) and begin to dissect up the strip. The strip comes off readily. However, one should be careful to keep the dissection at the same level to avoid perforation.

The bottom of the trough appears slate color. After completing the dissection, the bottom of the trough is treated with the ball electrode in a continuous way. The current should be light, about 30 to 40 ma., and applied so that the thin remaining floor is not completely destroyed. Sutures (braided 30-white silk) are then inserted either in mattress form or in a continuous manner.

With a 1.0 mm. or 1.5 mm. perforating diathermy needle single punctures are made slowly about one to two mm. behind the excised strip so as to permit escape of the subretinal fluid. Further escape of fluid can be expedited by massage of the globe or perhaps by enlarging one of the punctures with a probe, care being taken not to push the probe deeper than 1.5 mm.

Upon escape of the subretinal fluid, the globe softens and makes easy the approximation of the dissected scleral edges and the infolding of the thinned-out scleral floor. The detached muscle or muscles are reattached and the conjunctiva is closed with catgut. Atropine is instilled and both eyes are bandaged.

Discussion. Dr. Knapp said that in January, 1952, he spoke on the medical cure for detachment of the retina by dehydration. Did Dr. Berliner ever use this procedure?

Dr. Minsky complimented Dr. Berliner on his excellent presentation. He made the following three points: (1) Success of this operation depends on its being used as a primary procedure; (2) scleral resection should also be done as a primary pro-

cedure; (3) Schepens has operated a series of cases by a technique similar to Dr. Berliner's; his concept is to make a fold which projects into the contents of the globe.

Dr. Vesey said that mathematical figuring of how much we actually shorten the eyeball when we resect three mm. results in less than 1.5-percent shortening. Thus, shortening of the eyeball alone is not responsible for the good results in this type of procedure. He then asked Dr. Berliner why he uses diathermy puncture to release the subretinal fluid. Dr. Vesey said that it is his feeling that all the subretinal fluid must be let out to get good results. He also asked Dr. Berliner if he replaces the subretinal fluid.

Dr. Posner asked if diathermy punctures are needed in front of the incision, and also whether or not you are over the pars plana and not over the retina.

Dr. Berliner replied to Dr. Posner, that you are not in the pars plana since the subretinal fluid escapes from the subretinal space. To Dr. Knapp he said that he used to use a salt solution subconjunctivally, before the current operative procedure, but has never tried general dehydration. To Dr. Vesey Dr. Berliner said that other things may be involved in shortening the eyeball besides three to four mm. of shortening. Why it works is not known, perhaps the diathermy does it. To Dr. Minsky he said that he hadn't heard that Schepens did any lamellar resections, and he doesn't know what technique he uses.

Reading glasses for patients with very poor vision

Dr. Alfred Kestenbaum said that psychologically a person should not be regarded as actually blind, as long as he is able to read the print in books, newspapers, and typewritten letters. This means print of the size of about J5. Three optical devices are used to enable a patient with poor vision (after correction) to read: (1) An adequately strong plus glass while the print is brought closer to the eye; (2) a magnifying lens; (3) a telescopic loupe.

The adequate plus glass should not be found by the method of trial and error but be calculated from the found "far-vision." Studies showed that "far-vision" (Snellen's chart) and "near-vision" (Jaeger's test) are comparable with each other except in four conditions:

"Near-vision" was found better than "far-vision" in peripheral opacities of the cornea or lens and in uncorrected astigmatism. "Near-vision" was found poorer than "far-vision" in central opacities of the cornea or lens and in scotomas involving a part of the macular area.

For calculations of the required plus glass, the conception of "reciprocal of vision" or Rv was introduced. In 20/60 (after correction), Rv is 3; in 20/200, Rv is 10; in finger counting at five feet or 5/200, Rv is 40. The normal eye can read J5 at 102 cm.; an eye with an Rv of 10 (20/200) can read Jaeger type in a tenth of this distance, that is, at about 10 cm. But in order to read in 10 cm., the eye needs a plus glass of 10D. Hence for reading of J5, an eye requires a plus glass of just as many diopters as the Rv that has been found. Of course, the available amount of accommodation has to be subtracted. For reading of J3, the Rv has to be multiplied with the factor 1.4 to obtain the required number of diopters.

The so-called "magnification" of a magnifying lens equals one fourth of its strength in diopters. This rule is valid only if the object is standing in the focal plane of the lens. The "magnification" is meant in reference to the image of the object if it stood at the conventional 25 cm. or 0.25 m. from the eye. The "magnification" of the magnifying lens is independent of the distance between lens and eye.

To read Jaeger type by means of a magnifying glass, the eye again needs a lens of just as many diopters as its Rv is. The diopters of a lens corresponds with four times the magnification.

In a telescopic system for the infinity, the

"magnification" equals the strength of the ocular lens divided by the strength of the objective lens. The best available telescope gives a magnification of about 2.2 times. By addition of a plus glass to the system, the latter is changed to a telescopic loupe. To find the telescopic loupe required to read J5, again a "magnification" has to be taken which equals one fourth of the present Rv.

Practically, amblyopia or poor vision may be divided into three degrees:

1. Vision down to 20/70. Here approaching the print and use of stronger plus glass are the devices of choice.

2. Vision between 20/80 and 20/300. Here all three devices are available. Each of them has an especial disadvantage: a strong plus glass requires approach of the print, which is sometimes impractical; the magnifying lens, which gives the same "magnification" for any distance, gives a smaller field the farther it is held from the eye, in addition, one hand is occupied with holding the lens. The physician has to make his choice between these three devices according to the needs of the patient's occupation.

3. For poor vision from 20/400 down to finger counting at five feet, or 5/200, a new method was introduced, the use of small glasses, so-called microglasses. A "normal" eyeglass of 30 or 40 diopters would be worthless because of its severe peripheral abberations; these could be eliminated by use of a smaller glass.

A glass of plus-20 diopters with a diameter of 30 mm., a glass of plus-30 diopters with a diameter of 15 mm., and a glass of plus-40 diopters with a diameter of 12 mm. give very good images. Similar glasses have been used as so-called thread testers in industry. For reading, such a strong plus glass is ground and glued on a plane glass or is fixed to the frame in another way. The patient quickly learns to hold these glasses close to the eye.

Visual field defects in war casualties

Dr. Norman S. Jaffe said that this report is concerned with visual field defects due to trauma, typical of the current conflict. The lesions are restricted to those involving the geniculocalcarine pathway. The following factors are most important in the discussion.

1. *Congruity.* The most important single differential point between homonymous hemianopias due to anterior lesions (optic tracts and anterior radiations) and those due to posterior lesions (posterior radiations and occipital cortex) is the remarkable congruity of visual field patterns of the two eyes in the latter type. Congruity implies similarity of all portions of the field except the temporal crescents.

2. *Sparing of the macula.* This sign is of considerably less value. Sparing occurs typically in posterior lesions. It is most common in vascular lesions, less common in tumors, and least common in trauma. In the latter, the macula is usually split, central visual acuity remaining good.

3. *Associated signs and symptoms.* This is important in localization. Occipital lesions are usually "silent" while radiation lesions are almost always associated with other signs and symptoms.

4. *Shape of the field.* The presence of small homonymous hemianopic scotomas strongly indicates cortical or subcortical damage. The suprachiasmal path is most spread out here so that scotomas are common. Trauma is the most frequent etiology. A sharp rectilinear delimitation along the vertical and horizontal meridians indicates a radiation lesion. Characteristic of cortical defects is an irregular outline and a steep margin. Vascular lesions often result in field with regular and steep outlines.

5. *Course of the lesion.* When complete blindness is followed by recovery of an entire half field, the occipital cortex is usually involved. When sparing of the macula follows splittings, a vascular obstruction is indicated. The blindness may be due to a hemorrhage on one side which creates pressure on the opposite side. The length of this initial blindness varies considerably from minutes to days.

6. *Relation to subgeniculate lesions.* Subgeniculate lesions usually show incongruity. Splitting of the macula is not a reliable sign. The hemianopic pupillary response of Wernicke is difficult to elicit. Optic atrophy occurs but takes considerable time to reach the optic disc.

7. *Bilateral homonymous hemianopia.* This may be caused by two separate vascular accidents, one on each side of the brain, ependymitis of both lateral ventricles, tumor arising in the falx between the occipital lobes and trauma. Transverse bullet wounds will usually cause bilateral defects of a quadrantic nature. The lower quandrants are involved since traumatic superior altitudinal defects are only caused by lesions at the base of the posterior part of the brain. The proximity of the major blood sinuses makes it virtually impossible for an individual to survive such an injury.

Dr. Jaffe described the following cases: (1) Four cases of homonymous quandrantanopia; (2) four cases of homonymous hemianopia; (3) one case of homonymous paracentral scotoma; (4) and four cases of bilateral homonymous hemianopia.

Discussion. Dr. Max Chamlin: In regard to Dr. Jaffe's interpretation of poor fixation to account for overshooting of the field, Dr. Chamlin suggested another possible explanation, namely, that a traumatic lesion might actually produce sharply defined interference, thus sparing some fibers. Regarding cases of poorly defined homonymous defects, Dr. Chamlin pointed out that the irregular contractures due to prolonged papilledema may occasionally simulate incongruous homonymous hemianopic defects.

Dr. Alfred Kestenbaum complimented Dr. Jaffe on his good work. He said that it was too bad that he had never used the optokinetic nystagmus to distinguish between tract and optic radiation lesions. He said that incongruity is also found in cortical lesions. He agreed with Dr. Jaffe that the patients probably did have bad fixation. He remarked that disturbances in distance perception in bilateral homonymous hemianopia are often found. And he agreed with Dr. Jaffe as to why the lower fields are damaged more frequently than the upper field.

Dr. Arthur Linksz mentioned the work of Fuchs in determining the fixation point.

Dr. Adolph Posner said that the visual acuity and size of test objects used in this study were not mentioned by the speaker.

Dr. Jaffe replied, in regard to the question of faulty fixation, that it is an unsettled point whether this is due really to faulty fixation. To Dr. Kestenbaum, he said that optokinetic nystagmus has only theoretical value since the exact location of the lesion is known. In regard to incongruity, Dr. Jaffe said that you occasionally see it in cortical lesions. All these cases showed congruity. To Dr. Posner, he said that all the patients had 20/20 vision and the test objects varied with the instruments used.

Bernard Kronenberg,
Recording Secretary.

Ophthalmic Miniature

Where the patient is much broken down, and the disease is in a chronic stage, I beg to suggest the plentiful use of cod-liver oil, of which medicine a large supply should at once be procured, and a table-spoonful given to each child two or three times a day.

W. R. Wilde,
London Journal of Medicine, 1851.

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ANNUAL MEETING OF THE CANADIAN OPHTHALMOLOGICAL SOCIETY

The 16th annual meeting of the Canadian Ophthalmological Society was held at Minaki Lodge, Minaki, Ontario, June 14th to 16th. The attendance was excellent, and the program most interesting. Dr. E. P. Birch of St. Paul, Minnesota, was the guest speaker and gave a paper on the "Safeguards in cataract surgery." This was a most comprehensive and carefully thought-out discussion of the subject. He dealt with it under preoperative examination, the pyschologic and physical preparation of the patient, operative and anesthetic technique, and postoperative care and refraction.

Dr. S. T. Adams and Dr. J. R. Bourne of Montreal presented a "Report of 175 cases of glaucoma with special reference to classification, gonioscopy, and tonography." They

divided their cases basically into the open-angle and closed-angle groups with subdivisions of each. In their study there was good correlation between the tonogram and the status of the angle in the closed-angle types. They found that trephining operations normalize the tonogram. They found considerable difficulty in classifying borderline cases by these means.

Dr. R. J. MacDonald and Dr. T. H. Hodgson of Toronto, presented a report of their fundamental investigations on the aqueous flow. Their paper entitled "Slitlamp studies on the flow of the aqueous," described an improved method for accurately measuring changes in the concentration of fluorescein in the anterior chamber without disrupting the physiology of the eye. In these experiments, fluorescein was administered by instillation in the conjunctival sac. By slitlamp readings the concentration in the aqueous was read at intervals and thus the aqueous flow could be determined. They found that fluctuations in the bulk rate of flow, either spontaneous or following the installation of a myotic, were reflected in the changes in flow in the aqueous veins, but neither the fluctuations nor the aqueous-vein changes bore a constant parallel relationship to tonometry readings.

Case reports were presented on, "Sympathetic ophthalmia" by Dr. W. C. Guest of Winnipeg, on "Toxoplasmosis," by Dr. E. N. Wright of Port Arthur and by Dr. J. E. Rose of Winnipeg on "The entry of an oily ointment into the anterior chamber following a traumatic wound of the cornea."

In a paper on the "Histologic interpretation of fundus lesions," Dr. O. B. Richardson of Toronto showed several Kodachrome slides depicting the fundus picture and histologic changes in certain vascular lesions of the fundus.

Dr. J. C. Locke of Montreal presented a paper on "Retrolental fibroplasia," showing in its production the definitive role of oxygen administration to the premature infant. His very careful studies presented strong evidence that the administration of a superabundance of oxygen increases the incidence of this disease.

Dr. W. W. Wright reported on "The work of the C.N.I.B. for the blind and for the prevention of blindness." A most interesting genetic study of "Myotonia atrophia" and its ocular features was presented by Dr. J. Maciver of Owen Sound.

Dr. B. Alexander of Montreal presented a complete case history with pathologic slides of an exceedingly rare condition, "Astrocytoma of the retina."

Dr. J. A. MacLean of Vancouver reported on the results obtained in 17 cases in which the Ridley acrylic lens was used at the time of cataract extraction. He emphasized the importance of keeping the pupil mobile after operation and properly selecting the patients.

Dr. E. Powell of Port Arthur discussed the "Treatment of congenital ptosis," and presented his results obtained in treating several patients with this disturbance. In those cases in which there is no levator action he prefers the fascia-lata sling operation of Wright.

Dr. J. V. V. Nicholls of Montreal presented a clinical study of seven cases in six patients of "Macular edema in association with cataract extraction." The clinical findings indicated that the basic cause was a vascular dysfunction of an arteriosclerotic or an arteriospastic nature, and that the precipitating cause was anxiety in some cases and prolapse of the vitreous forward through the pupil in others.

Dr. J. H. Quigley and Dr. J. F. Ballantyne of Toronto presented the results of a study on the "Antibiotic sensitivities of strains of Staphylococcus aureus recovered from eye cultures." They found in 146 cases of coagulase-producing Staphylococcus aureus that 32.9 percent were sensitive to penicillin, 69.2 percent to aureomycin, 71.2 percent to streptomycin, and 82.2 percent to chloramphenicol. Apparently resistant strains were more common among hospital patients.

Dr. C. H. Andrews of Prince Albert,

showed the importance of proper centering of lenses, centration being determined by the power of the lenses, and in readers by the reserved power of convergence.

John V. V. Nicholls.

GOLDEN JUBILEE OF THE EGYPTIAN OPHTHALMOLOGICAL SOCIETY

The Golden Jubilee meeting of the Egyptian Ophthalmological Society was held in Cairo, February 15th to 28th, under the chairmanship of the president of the society, Dr. Mohamed Tewfik. It was attended by visitors, several hundred in all, from all over the world, but particularly from the Arab countries of the Middle East. The World Health Organization contributed to the meeting by sending a group of six ophthalmologists from Europe and the United States to participate in the proceedings and to conduct a co-operative seminar for the 10 days immediately following the congress. The congress met in the offices of the Egyptian Medical Association and the seminar was held at the Kasr-el-Aini Hospital and the Giza Memorial Ophthalmic Laboratory.

The meeting was opened formally with an address of welcome by His Excellency Nureddin Tarraf, Minister of Health. This was followed by addresses by Dr. A. T. Shousha, regional director of the World Health Organization, and Dr. Mohamed Tewfik, the president of the society. Dr. Tewfik's address concerned the founding of the society and its important role during the past 50 years in the dissemination of ophthalmologic knowledge and the improvement in ophthalmologic care. These talks were followed in turn by the Suleiman Lecture of the Ophthalmological Society of Egypt which was given by Prof. Karl Lindner of Vienna, chairman of the World Health Organization group. Dr. Lindner's subject was "Improvement or cure of myopia by one or two stage scleral resection." The annual Suleiman Lecture was founded in 1940 in memory of the late Prof. Sayel Abd El Hamid Suleiman Pasha.

The program of the congress proper consisted in five communications by other members of the World Health Organization group, and in 48 short communications, many of them of unusual interest and importance. Signal among these were the following:

A report of three cases of gumma of the orbit by Prof. M. A. H. Attiah; a report on epidemics of virogenic acute keratoconjunctivities with membrane formation and herpetiform vesicular eruptions by Dr. I. A. Mohamed and Dr. G. Badir; a contribution to the histopathogenesis of trachoma by Dr. G. Badir; papers on trachoma control by Dr. F. Maxwell Lyons, and on the triple symptom complex of Behçet by Dr. M. Bishay; a report of two cases of Vogt-Koyanagi syndrome by Prof. A. M. Soliman; notes on the surgical control of glaucoma secondary to essential atrophy of the iris by Dr. Sabri Kamel, and on experience with cyclodiathermy for glaucoma by Prof. M. A. H. Attiah and Dr. Aly Mortada; the first report of an Egyptian case of retrolental fibroplasia by Prof. A. M. Soliman and Dr. M. El-Arabi; and reports on Echinococcus cyst of the eyeball by Dr. Olga Litricin of Yugoslavia, and on Ascarides in ophthalmology by Dr. Dusan Dobrovic, also of Yugoslavia. In addition to the reports, a number of films were shown; these dealt with surgical subjects and were of both European and American origin.

In view of the outstanding importance of the ophthalmias in Egypt, it was to be expected that keratoconjunctivitis would be the subject of many papers. There seemed to be general agreement that the acute ophthalmias complicating trachoma were being satisfactorily handled by the sulfonamides or antibiotics but that the incidence of trachoma itself had not yet been markedly reduced. There seemed to be considerable hope, how-

ever, that the trachoma situation could now be improved, particularly with aureomycin and terramycin.

The seminar which followed the congress included morning operating sessions, lectures, symposia, and discussion groups. In the nine allotted days these covered all phases of ophthalmology. Lectures given by the World Health Organization group were entitled, "The etiology and treatment of uveitis," by Dr. R. Thiel of Frankfurt; "The pathology of the vitreous," by Dr. K. Lindner of Vienna; "The physiology of the eye," by Dr. D. G. Cogan of Boston; "The proliferative type of diabetic retinopathy," by Dr. H. Ehlers of Copenhagen; "The treatment of chronic glaucoma," by Dr. T. K. Lyle of London; and "Follicular conjunctivitis," by Dr. P. Thygeson of San Jose. The discussion groups and the presentation of clinical material were offered jointly by the members of the World Health Organization group and their Egyptian colleagues.

The members of the World Health Organization group will long remember the Egyptian hospitality extended to them. It included many banquets and such interesting entertainment as the never-to-be-forgotten excursions to the Sphinx and Pyramids at Giza, the Pyramids and Necropolis at Sakhara, the Egyptian Museum, and the very lovely private estates in the country outside Cairo. As a member of the World Health Organization group I was much impressed by the high caliber of Egyptian ophthalmology, by the very great progress that has already been made in the control of the ophthalmias and other complications of trachoma, and especially by the lively interest shown by the young Egyptian ophthalmologists and their older colleagues in the proceedings of the congress and seminar.

Phillips Thygeson.

ANNUAL MEETING OF THE IRISH OPHTHALMOLOGICAL SOCIETY 1953

The 32nd annual meeting of the Irish Ophthalmological Society took place in Dublin on the 16th to 18th of April under the presidency of Dr. Dermot O'Donoghue. This society of 78 members, founded in 1917, shares with the Irish Rugby Football Union the almost unique privilege of representing the whole island of Ireland ignoring The Border.

The meeting opened in the Royal College of Surgeons (Ireland) with the delivery of the 38th Montgomery Lecture. This annual lecture which brings such color and interest to our meetings was founded under the will of Dr. R. Montgomery (1916) and alternates every five years between the Royal College of Surgeons in Ireland and Dublin University. These bodies very graciously consider nominations for the lecturer from the Irish Ophthalmological Society. This year the choice was Prof. Marc Amsler and his subject "The early diagnosis of macula disease." It is unlikely that any Montgomery Lecture has excelled and certainly few have equalled that of Prof. Marc Amsler. Here was a clarion call for active treatment in cases of early macula disease. (This lecture will be published in the *British Journal of Ophthalmology*.)

That evening the annual dinner of the society was held in Jammet's Restaurant when 39 members met to dine with their distinguished guests, Prof. Marc Amsler (Zurich), Dr. Algernon Reese (New York), and Mr. Adams McConnell (Dublin).

On the following morning some 30 clinical cases and demonstrations were shown and later discussed in the Royal Victoria Eye and Ear Hospital. To whet the palate of our American guest two tit-bits of pathologic interest were presented. These, a case of leiomyoma of the iris and one of synovioma of the troclear pulley, were fully and beauti-

fully demonstrated by Dr. O'Meara, professor of pathology in Trinity College, Dublin University. The synovioma, removed from the orbit of a boy three and one-half years of age, was considered by Professor O'Meara to be as yet unique in the literature. (It is hoped to publish this case in the AMERICAN JOURNAL OF OPHTHALMOLOGY.)

Among the cases of surgical interest shown were two with acrylic Ridley lenses demonstrated by Dr. Werner; tumor of the iris removed by Stallard's operation, and a bilateral Summerskill operation for chronic dacryocystitis both shown by Dr. F. S. Lavery. Dr. Crookes had an excellent result in congenital ptosis following Trainor's operation, and Dr. Harris Tomkin a hemangioma of the orbit removed by the Krönlein approach.

Dr. Mooney's fine exhibit of neurologic X-ray films, with their fields and scotomas from the Neurological Unit of the Richmond Hospital caused unusual interest and not a little envy.

Among cases of general clinical interest were two tumors of the iris (Dr. Philomena Guinan), three children of a family with primary degeneration of the retina showing the condition from its very earliest beginning to the fully formed fundus of retinitis pigmentosa (Dr. Somerville-Large), an unusual case of corneal degeneration (Dr. Maxwell), and a total unexplained retinal detachment (Dr. Roche).

Following the morning clinical session some 35 members and their guests repaired to the Shelbourne Hotel for the informal annual luncheon of the society.

The afternoon session was devoted to the surgical approach of orbital tumors. The opener, Dr. Algernon B. Reese, having first shown the film of his lateral approach, delivered his paper "Diagnosis and treatment of tumors of the orbit." Then Mr. A. Dickson Wright, president of the Society of British Neurological Surgeons, followed with his "Osteoplastic approach to the orbit" and demonstrated his film. This paper was enhanced by a splendid pathologic specimen of two eyeballs with the enlarged flattened muscles of toxic goiter attached. Finally Mr. Adams A. McConnell (Director, Neurosurgical Unit, Richmond Hospital, Dublin), our guest speaker for these papers, with clarity and wit summarized the position. These two approaches to an ever-present surgical problem, so vividly described, made a truly fascinating comparison. What will certainly be recalled when the memory of the session has faded is Dr. Algernon B. Reese's 3,000 mile journey solely to attend our meeting—a gesture unique in the annals of our society.

Thus, our little society, existing on the fringe of the European and American ophthalmological worlds, enjoyed at the same meeting a leading ophthalmologist from each, emphasizing to us once again the attraction of the small intimate scientific gathering. Following keen discussion on these papers, a delayed tea was welcomed to finish the day's scientific session.

On the final morning of the meeting three papers were read: Dr. F. S. Lavery and Dr. Sheila Kenny, "Curare in ophthalmology"; Dr. T. J. Macdougald, "An ophthalmologist enlarged"; and Dr. A. J. Mooney, "A preliminary report on the clinical use of Neosone."

Dr. Sheila Kenny, ophthalmic anesthetist to the Royal Victoria Eye and Ear Hospital, read a thought-provoking account of the use of curare in ophthalmic surgery inspired by Dr. Daniel B. Kirby's Montgomery Lecture of 1949. Dr. T. J. Macdougald described his visit, carried out last month, to the three leading ophthalmological clinics in Switzerland, Professor Franceschetti's clinic at Geneva, Professor Amsler's in Zurich, and Professor Goldmann's in Berne. He stressed the very high degree of perfection that Professor Amsler's new clinic had achieved in its construction and the thoroughness and rapidity with which patients could be examined. He made also an interesting point on Professor Goldmann's enthusiasm and ability for designing new instruments, later

to be carried out practically in the fine craftsmanship of the Haag-Streit workshops.

This paper stimulated Professor Amsler to produce one of the highlights of the meeting. Standing among the audience he described with bubbling wit and in vivid drama his operation of keratoplasty, holding us fascinated by the thrilling events occurring in the anterior chamber before our very eyes. A colorful episode all too uncommon at scientific gatherings.

Neosone is a new preparation, a combination of cortisone and neomycin. Dr. Mooney was able to give a very satisfactory account of its value in anterior diseases of the eye.

This terminated the scientific side of our meeting, nothing remained but a race meeting, a round or two of golf, and a final dinner party before we found ourselves saying good-bye to our guests with even more gratitude and more unwillingness than is our wont.

Apart from the Montgomery Lecture, all the papers of the society's meeting will be published as usual in the Irish Ophthalmological Society's section of the *Transactions* of the Ophthalmological Society of the United Kingdom.

L. B. Somerville-Large.

EDITOR'S POSTSCRIPT. Dr. Somerville-Large's modesty prevented him from mentioning that, in September, 1952, he established an annual award to the clinical assistant of the Royal Victoria Eye and Ear Hospital, Dublin:

1. To enable the junior ophthalmic specialist attached to the hospital to acquire not only practical experience in recent ophthalmological work outside Ireland but, through meeting leaders of the profession, to obtain personal contacts in world ophthalmology.

2. Through the experience thereby gained to assist in keeping the ophthalmological work of the hospital in line with modern advances.

3. To enable, through the Irish Ophthalmological Society, other Irish ophthalmic specialists to learn in a practical manner of the work that their contemporaries are doing aboard.

BOOK REVIEWS

HUMAN FACTORS IN AIR TRANSPORTATION. By Ross A. McFarland, Ph.D. New York, McGraw-Hill, 1953. Price: $13.00.

This book represents a truly monumental effort in the compilation of information on aviation medicine. It is not written for the aviation medicine specialists alone but for the personnel manager, the safety superintendent, the operations staff, and the insurance expert as well. The coverage of the book can perhaps be most readily judged by its table of contents which is as follows:

Part I. Introduction—Nature and extent of airline operations.

Part II. Selection and training of flight personnel.

Part III. Maintenance of health and efficiency of flight personnel.

Part IV. Selection, placement, and health of ground personnel.

Part V. Safety on the ground and in flight.

Part VI. Sanitation and health in airline operations.

Part VII. Passenger and service problems.

Part VIII. Health and medical services in air transportation.

A great deal of research in the field of aviation and its allied sciences has been reviewed and quoted. As a result the bibliography given at the end of each chapter is one of the most valuable parts of the book.

This is an excellent general reference book on the subject of aviation medicine; as a reference for the aviation ophthalmologist, it cannot be so highly recommended. It suffers in this respect from the fact that it was written for such a wide-reading group. This necessitates, for example, the inclusion of such items as a discussion of types and causes of heterophoria and types of refractive errors. There are discussion on vision and visual functions under most of the sections of the book. In general, these are well handled.

The largest section in this book having to do with ophthalmology is the one on the

examination of the eyes as a selection procedure for flying. This portion, however, contains a good many errors and inconsistencies. For example, a statement that night myopia is a problem of automobile drivers (which it is not if headlights are used); that normal color vision is important in terrain recognition; recommending that uncorrected visual acuity in each eye be not less than 20/40, but at the same time suggesting that the maximum myopic refractive error be three diopters; lists incorrect cut-off points for the red lens test; commends use of projected type of visual acuity charts, and so forth. This chapter has many valuable references, but the recommendations and conclusions are not always consistent.

In summary, then, this is a very valuable book for the aviation medicine specialist. It is also very valuable for the aviation ophthalmologist for information on flying, as a general reference book and for bibliographies on aviation medicine. These uses far outweigh its defects as a source of specific aviation ophthalmology information.

Victor A. Byrnes.

TRANSACTIONS OF THE INTERNATIONAL OPTICAL CONGRESS, 1951. London, The British Optical Association, 1952. 493 pages, illustrated, paper-covered. Price: Paper, £2.12; cloth, £3.12.

The International Optical Congress, an organization essentially of optometrists, met in King's College, London, with representatives from 24 countries. The opening address was given by Sir Harold Hartly, chairman of the Council of the British Association for the Advancement of Science. Though the honorary membership includes Sir Stewart Duke-Elder, no ophthalmologist was on the program which included extensive symposia on the ophthalmoscope, contact lenses, and orthoptics, besides many special papers—among which were Fincham on accommodation, Bannion on developments in aniseikonia, Swann on refraction of children, and Freeman on the centenary of the cross-cylinder.

Freeman stressed that a reliable response from the cross-cylinder required circular fixation targets, and incidentally discussed the very limited clinical value of refractionometers. Swann considered that cycloplegics were indispensable in the refraction of children. In Britain, the ophthalmic optician (the British equivalent for optometrist) is permitted to use and prescribe these drugs. The substitution of the term, "visual skills training," for orthoptics, is now in vogue among American optometrists and this semantic shift is gaining ground in England.

The symposium on the contact lens was especially outstanding. A survey of keratoconus cases fitted revealed that 85 percent were wearing their contact glasses, and of these 89 percent were using them daily, and 37 percent for more than eight hours per day. Special contact glasses made by the molding technique have been used successfully for cosmetic purposes over disfigured eyes, in nonoperative strabismus, and in congenital aniridia—the cost is often defrayed by the British National Health Service. For ordinary cases the minimal-clearance type is favored as most likely to give comfortable and veil-free wear.

James E. Lebensohn.

TRANSACTIONS OF THE OPHTHALMOLOGICAL SOCIETY OF THE UNITED KINGDOM, 1952, Volume 72, 743 pages. London, J. & A. Churchill, Ltd. Price: Not listed.

The present volume comprises the proceedings of the Ophthalmological Society of the United Kingdom and the Affiliated Societies for 1951-52. The papers and clinical case reports are numerous, concise, and of general interest.

The Montgomery Lecture, given by Derrick Vail, concerned the diffuse collagen diseases with ocular complications. The common factor of degeneration or necrosis of collagenous or connective tissue is present. In the eye collagenous tissue is present in the cornea, sclera, Tenon's capsule, muscle ten-

dons, the supportive tissue of the blood vessels, and the optic nerve. Included in this group of diseases are disseminated lupus erythematosus, periarteritis, or polyarteritis nodosa, scleroderma, dermatomyositis, rheumatoid arthritis, and rheumatic fever. These diseases may follow a variety of damaging stimuli. Evidence of indicates that ACTH and cortisone act by blocking the inflammatory response of the collagenous tissues.

Several papers on the value and mode of action of ACTH and cortisone were presented. Alan C. Woods finds their greatest usefulness in allergic reactions of the external eye and nongranulomatous inflammation of the uveal tract. When employed in chronic infections, specific antibiotic or chemotherapeutic measures should also be used to eliminate the basic infection.

D. P. Choyce stresses the difficulty of making an exact diagnosis of ocular tuberculosis since accuracy requires the demonstration of tubercle bacilli in the lesion. Woods has obtained promising results with therapeutic agents. Tuberculin "should be used for one purpose only—to remove the fatal tissue hypersensitivity." The dose should be below the patient's point of reactivity.

A well-illustrated paper by Bernard Samuels stresses the factors producing internal gaping of corneal wounds after injuries and operations: Descemet's membrane retracts and often folds, the longer incision used in cataract surgery with or without sutures favors gaping and the development of anterior synechias and secondary glaucoma.

In evaluating the long-term results of treatment on concomitant convergent strabismus in terms of binocular function, G. T. Willoughby Cashell concluded that one third of all the cases regained single binocular vision, in one half of these cases fusion was present initially. The late onset of strabismus is an important factor in the prognosis—this is also emphasized by A. A. Douglas, Whittington, Houlton, Lyle, and others in discussing the orthoptic and/or surgical treatment of squint.

The Doyne Memorial Lecture was presented by Dorothy Adams Campbell on "Ophthalmic stress" which, in this period of international stress, may result in emotional and mental stress associated with ocular strain and disorderly ocular function. The evaluation of the physical and psychologic factors seems to be largely determined by the investigator of the problem—an introvert sees the problem as psychomatic; the extrovert sees in terms of physical medicine. Selye has correlated many diseases such as rheumatic fever, asthma, periarteritis nodosa, hypertension, nephrosclerosis, ulcerative colitis, peptic ulcer, and allergic manifestations as general diseases of stress. So we should look firstly for evidence of mental or emotional stress, secondly for hormone disturbances, and thirdly for accompanying biochemical changes of significance. Campbell's observations on sodium and water metabolism indicate that a high level of blood sodium and in turn water retention is an indicator of tension or stress. The triad of stress, hormonal factors, and biochemical changes, as set up for speculation by Campbell, is most intriguing and open to quiet speculation.

The revolution and evolution of ocular therapeutics in the last 30 years has been accomplished in the fields of antibiotics, chemotherapy, and psychology.

The wide field of interest and the appreciation of the work of the ophthalmologists of the United Kingdom is more than maintained by the *Transactions* of 1951 and 1952.

The only criticism of the publication is the increasing use of confusing abbreviations such as T.A.B., E.S.R., H.P.C., I.K., P.A.B.A., and so forth.

William M. James.

Bulletin de la Société Belge d'Ophtalmologie, 1951. No. 99, pp. 403-550. Bruxelles, Imprimerie Med. and Scient. Rue de l'orient, 67.

This volume contains the *Transactions* of the Ophthalmological Society of Belgium for November, 1951.

M. Amsler discusses the surgery of the anterior chamber as a primary operation and as an additional maneuver in cataract extractions and keratoplasties. He emphasizes the diagnostic and curative importance of this procedure which he compares in its significance to lumbar puncture.

Hoorens and Philipps report their research concerning the miotic action of DFP. Its effectiveness is not only caused by blocking cholesterinase and activating acetylcholine. They resected the ciliary ganglion and the postganglionic fibers of cats and DFP did not counteract the resulting mydriasis. The mydriasis persisted when the superior cervical ganglion was destroyed; but at this stage the DFP contracted the pupil, an action which authors could not explain by the liberation of acetylcholine. They believe that the sympathetic not only innervates the dilator pupillae but also exerts an inhibiting action on the sphincter, a theory which was not shared by all discussers.

R. Weekers and E. Prijot studied the result of retrociliary diathermy applications on the ocular tension, using the electronic tonometer. They found that the main effect of this diathermy puncture is a reduction in the formation of the aqueous. They evaluate this procedure as complimentary to iridencleisis but warn not to use it more often than twice because of the danger of cataract formation.

M. Appelmans and J. Blockeel studied the bovine vitreous under the electronic-microscope with a magnification of 60,000.

J. Zanen, R. Wibail, and R. Delcourt gave an interesting comprehensive picture of temporal arteritis and reported a case history.

M. Appelmans, L. Mortelmans, and J. De Peuter discussed the ophthalmo-sylvian syndrome of d'Espildora-Luque. This syndrome is the result of a disturbance of circulation at the bifurcation of the left internal carotid artery. Its manifestations are unilateral blindness, contralateral hemiplegia, and an ataxic aphasia.

J. Francois gave a very interesting account on the clinical evaluation of electroretinography. He came to the conclusion that with the facilities at hand the value of retinography was very limited, as it only registers the activities of the rods. He suggested a future simultaneous investigation of the retinal response and the response of the optic pathways by combining studies of the electroretinogram and the electroencephalogram.

J. Dedoyard and F. Paussel summarized their experience with cortisone. J. Zanen explained the Troxler phenomenon and reported its application in four patients.

J. Francois, Boels, and M. Rabaye observed choroidal metastasis of a suprarenal tumor. The primary tumor was only discovered at autopsy and was classified as an epithelioma of the alveolar layer of the suprarenals; only one similar case has been published.

Other papers presented included J. Dedoyards and E. Prijot's paper on corneal edema in keratoconus, the description of a shell for the protection and fixation of the transplants in keratoplasties by Fritz, and the description of a case of acute glaucoma by the same author. A. Meunier and P. Bousin discussed the etiology of grouped retinal pigmentation. J. Francois and G. Verriet gave a detailed clinical and statistical report on monocular retinitis pigmentosa. A. De Jaeger and I. Bernolet outlined their treatment of amblyopia.

M. Appelmans, J. De Niel, and P. Lebas surveyed the pathogenesis of retinal tumors, the limitations of the present irradiation therapy, and the possibilities of the use of isotopes.

Alice R. Deutsch.

RANIEVOI PROTZESS V. GLAZU. (The Process of Trauma in the Eye.) By E. F. Levkoeva. Moscow, Academy of Medical Sciences, 1951. 151 pages, with numerous illustrations. Price: Not listed.

The author of this monograph is both an ophthalmologist and pathologist. She has

been in charge of the Department of Pathology of Helmholtz Central Institute of Ophthalmology during the last 20 years and has accumulated a wealth of knowledge on injuries of the eye—over 6,000 enucleated eyes were examined by her during this period (including the years of World War II).

Levkoeva attempts to present systematically the various stages of injury in the eye and also the clinico-anatomic approach to the injured eye.

The monograph contains 13 chapters, the more important of which are these: (1) The clinical picture of penetrating injuries of the eye; (2) the pathologic picture of the wound of the external membranes of the eye; (3) the pathologic picture of the wound in deep penetrating injuries; (4) injury of the lens; (5) changes in the retina in eye injuries; (6) the process of infection in injury; (7) sympathetic ophthalmia; (8) the process of healing in the injured eye; (9) the organization of foreign bodies within the eye.

An appendix deals with serious trauma of the eye with glass and fragments of explosive bombs during an air attack. In 42 enucleated eyes so injured, there were perforating injuries of the sclera.

The author prefers suturing the sclera in any gaping wounds or perforating injuries of the eye to Kuhnt's conjunctival flap, since she found that more eyes had to be enucleated with this method than when sutures provided proper apposition of the edges of the wound.

In the chapter on "Regeneration of the wound limited by the external membranes," the author relates her interesting experimental work: transplantation of cornea into the anterior chamber and the regeneration of the corneal and scleral tissue in injuries. In the proliferative processes observed in eyes enucleated because of trauma, the tissue elements show a true cytotypical growth characteristic of cultures of tissues in vitro. The culture of Schwann's cells, pigment epithelium, and ciliary epithelium in the anterior chamber shows the excessive regenerative process in the eye. Excellent microphotographs illustrate this part of the experimental work.

Levkoeva supports the endogenous theory of development of sympathetic ophthalmia. The very few cases of sympathetic ophthalmia observed in extensive eye injuries with prolapse of important parts of the eye speak against the exogenous infectious factor. The similarity of the pathologic picture of tuberculosis and sympathetic ophthalmia is discussed. The increased sensitivity to sympathetic ophthalmia in young subjects could be linked to the absence of immunity to tuberculous infection in young individuals.

She expresses the opinion that too many eyes are enucleated for fear of sympathetic ophthalmia.

A number of fine microphotographs illustrate the monograph. The print is good. In order to appreciate this book, one has to read its complete translation; it can be highly recommended as a valuable addition to the library of ophthalmologists and ophthalmic pathologists. An extensive bibliography of Russian, German, English, and French literature is given.

Olga Sitchevska.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Akiya, H. **Histochemical study of visual cells.** Acta Soc. Ophth. Japan **57**:175-179, April, 1953.

Sections were made from the eyes of frogs after a freezing dehydration and stained with some of the mitochondria stainings; e.g. Heidenhain's iron-hematoxylin or Altmann's aniline-fuchsine staining after a mitochondria fixation with chromic acid-potassium bichromate-osmic acid mixture. The medial and outer parts of the rods and cones were stained intensively, the medial part in particular.

The frog retina was treated with 43 percent cane sugar solution. After centrifugation at 6,000 rpm for 10 minutes, the supernatant fluid was diluted to get a 33 percent sugar solution. The solution was centrifuged at 16,000 rpm for about 15 minutes. Granules of about 0.5 micron in diameter were obtained as the sediment. The author believes that the granules originate from the middle and outer parts of the visual cells and have physical properties common with mitochondria of the rat liver reported by Hogeboom and his associates (J. Biol. Chem. 172:619, 1948). The sediment was analysed chemically and the ratio of RNA-phosphorus in microgm. to total nitrogen in mg. proved to be 15.1 on the average. The figure is similar to that of mitochondria (15.5) reported by Hogeboom. Yukihiko Mitsui.

Eayrs, J. T. **Relationship between the ganglion cell layer of the retina and the optic nerve in the rat.** Brit. J. Ophth. **36**: 453-459, Aug., 1952.

The effects of interrupting the optic nerve in immature animals was used to study the relationship between the ganglion cell layer of the retina and the optic nerve in the rat. The optic nerve on one side was crushed and the effects noted. The portion of the optic nerve distal to the crushing showed complete degeneration. The intracranial course of the nerve was sometimes marked by a fine fibrous strand, but often no trace of the nerve remained. The optic nerve stump consisted mostly of fibroblasts and collagenous connective tissue. Externally the globes appeared normal but lighter in weight. There was no interference with the differentiation of the outer layers of the retina, but the ganglion cells were considerably reduced in number. Axons

could not be distinguished. It is shown that many cells remain in the ganglion layer long after complete destruction of the optic nerve. There was total disappearance of fibers both in the optic nerve and in the fiber layer of the retina. The importance of these findings in retrograde degeneration and the relation of the ganglion cells to the optic nerve fibers is discussed. Orwyn H. Ellis.

Koch, Carlo. **Filaments of the vitreous body.** Ann. di ottal. e clin. ocul. **78**:881-892, Oct., 1952.

In a microscopic study of the morphologic structure of the vitreous body of the great tunny (Thynnus thynnus) Koch found two kinds of filaments, each with its own characteristic micellar structure. These filaments resemble artificial textile fibers in their elasticity and resistance to traction. The orderly sequence of droplets along the filaments can be explained by the mechanism of detachment and falling of a drop. (6 photomicrographs, references) Harry K. Messenger.

Sakamoto, M. **Embryology of the third, fourth and sixth cranial nerve.** Acta Soc. Ophth. Japan **57**:146-148, March, 1953.

After a histological examination of 28 human embryos, Sakamoto concludes that, at the fifth week, the oculomotor nerve can be observed as an elongation of the midbrain. Between the sixth and the seventh week the trochlear nerve begins to develop. In the eight week the abducens nerve becomes recognizable. By the end of the eight week all of these nerves reach the respective muscles. It is emphasized that these nerves develop independently of the trigeminal and facial nerves. Yukihiko Mitsui.

Yamamoto, Y., and Matsusaka, T. **The nature of the crystalline substance in horizontal cells of the retina.** Acta Soc. Ophth. Japan **57**:251-252, May 1953., and Matsusaka, T. **The nature of the horizontal and amacrine cells of the retina.** Ibid. **57**:252-254, May, 1953.

In the first study the authors examined the horizontal cells of the human retina histochemically. The rod-shaped, crystalline substance in the horizontal cells first described by Kolmer was positive for Feulgen reaction. The authors consider the substance to have desoxyribose nucleic acid.

In the second report, the author states that the horizontal cells and amacrine cells of frog and cat retinas have granules which are stained violet by Hotchkiss' method and are digestible with diastase. The author considers these cells to be closely related to glia cells rather than to nerve cells. Yukihiko Mitsui.

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Bruna, F. **Experimental research on the action of the virus of epidemic parotitis on the eye tissues of rabbits, guinea pigs and rats.** Boll. d'ocul. **32**:13-35, Jan., 1953.

Contrary to the results published by Bolin, Anderson and Leymaster (1950), the author found no severe corneal lesion after inoculation of mumps virus into the anterior chamber of rabbit, guinea pig, and rat. Both allantoic and amniotic fluid of chick embryos, infected with three different strains of mumps, were used. One of the strains was isolated from the spinal fluid of a patient suffering from parotitis and meningitis. The material was introduced into the anterior chamber or into the cornea by intralamellar application or by the scratch method. Only with chamber inoculations was a mild iritis produced which the author ascribes to irritation from the culture medium. If, however, the inoculation was made into the vitreous, optic neuritis almost constantly ensued and led to partial or total optic

nerve atrophy. Sections of the affected nerve tissue showed definite signs of inflammation, hyperemia, and mostly lymphocytic infiltration. Here too, the author ascribes the disturbance to a toxic effect rather than a real virus infection because of the early disappearance of the virus from the vitreous, the negative results of passage experiments, and the proportionality of the lesion to the degree of dilution of the inoculated virus. On guinea pigs and on rats, inoculation into the anterior chamber and into the vitreous did not produce any pathologic changes. (Table showing agglutination data, 8 photomicrographs, references) K. W. Ascher.

Carta, R., and Toxiri, A. **The ability of horse and ox [corneal] proteins to produce anaphylactic reactions in guinea pigs.** Ann. di ottal. e clin. ocul. **78**:633-638, Aug., 1952.

Experiments with guinea pigs showed that the corneal proteins of the horse and the ox have the same antigenic properties as corresponding quantities of their serum proteins. The animals were first prepared with an intraperitoneal injection of corneal proteins. Three weeks later they received an intracardiac injection of the same proteins, with resulting anaphylactic shock except in those animals that received less than 10 mg. per kg. This may explain why some observers have concluded that corneal tissue has no antigenic properties. (References)

Harry K. Messenger.

Mitsui, Y., Tsutsui, J., and Tanaka, C. **Electron-microscopic study of Chlamydozoon trachomatis.** Brit. J. Ophth. **36**:582-585, Oct., 1952.

Scrapings from cases of trachoma were studied with the electron-microscope. The size and form of the virus apparently seen corresponded with present information. What was thought to be an early-stage colony or morula was noted. No similar observations were made in the non-trachomatous control group.

Orwyn H. Ellis.

Nakayama, H. **A study of tuberculous allergy of the eye.** Acta Soc. Ophth. Japan **57**:123-127 & 172-174, March, 1953.

The tuberculin reaction of the rabbit conjunctiva turns positive after an injection of B.C.G. and the positive reactivity lasts for 8 to 9 months. A re-injection of B.C.G. results in a rapid re-development of a strong reactivity. A repeated subconjunctival injection of a small amount of tuberculin during the positive period results in a rapid topical desensitization. In B.C.G. sensitized rabbits, a production of hetero-hemagglutinin in the aqueous is accelerated. The B.C.G. sensitization does not result, however, in a positive Middlebrook-Dubos reaction of the aqueous.

Yukihiko Mitsui.

Redi, F., and Miglior, M. **Changes in the permeability of the blood-ocular barrier induced by Filatov's implants.** Rassegna ital. d'ottal. **21**:501-512, Nov.-Dec., 1952.

Seven patients with medium and higher degrees of myopia were treated by implantation of placental tissue. A marked reduction of ciliary permeability was noted, and the process of normalization was maintained for long periods of time after treatment had ceased. The observation contributes, at least partially, to an explanation of the pharmacologic process of the beneficial action of the tissue implant in myopia of high degree. (1 figure, 19 references) Eugene M. Blake.

Sezer, F. N. **Cultivation of virus of epidemic keratoconjunctivitis on chorioallantoic membrane of fertile egg.** A.M.A. Arch. Ophth. **29**:293-302, March, 1953.

This is the first report of the successful production of typical pathologic changes of epidemic keratoconjunctivitis on chorioallantoic membrane. The virus

was isolated and can be maintained indefinitely on chorioallantoic membrane. The technique of isolation, culture and transfer, and the characteristics of the virus are described. Koch's postulates seemed to be fulfilled in this study.

G. S. Tyner.

Toxiri, A., and Carta, R. **The anaphylactic power of aqueous extracts of the substantia propria of the cornea and of aqueous extracts of the whole cornea kept at 3°C.** Ann. di ottal. e clin. ocul. **78**:639-644, Aug., 1952.

The authors found that the substantia propria of the cornea of guinea pigs has the same antigenic properties as whole cornea. Extracts of whole cornea that have been kept at 3°C. without exclusion of air are slightly less antigenic than if air has been excluded by immersion in paraffin oil. It is presumed that the exclusion of air retards autolysis of the corneal proteins. (References)

Harry K. Messenger.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Alagna, G. **The influence of vitamin E on alloxane cataract.** Arch. di ottal. **56**: 419-447, Nov.-Dec., 1952.

Twenty rabbits received one intravenous injection of 5-percent alloxane (200 mg. per kg. body weight). Every few days blood sugar, azotemia, glycosuria, and acetonuria were checked. The eyes were examined at short intervals under mydriasis. The animals were divided into three groups: the animals in the first received only alloxane, those in the second group received daily injections of 200 mg. vitamin E for 10 to 15 days before the alloxane injection, and those in the third group received an initial dose of 200 mg., then 100 mg. daily of vitamin E for several weeks after alloxane diabetes had set in.

In the first untreated group, the typical phases of diabetes were observed. Three animals developed lens opacities. In the group pretreated with vitamin E, diabetes developed also, but in a less severe manner; one animal out of six developed a cataract. The animals receiving vitamin E after the alloxane injection also developed diabetes, but in a less severe form, and three of eight showed lens changes, but again these changes were less pronounced than in the untreated animals. It is concluded that vitamin E is capable of reducing the incidence and retarding the development of the alloxane-diabetic cataract, probably by influencing favorably the enzymatic and respiratory processes in the lens. (5 figures, 30 references)

John J. Stern.

Alajmo, A. **Experimental use in ophthalmology of pancreatic enzymes.** Arch. di ottal. **56**:238-248, May-June, 1952.

A proprietary preparation containing fibrolytic enzymes proved to have no value in the treatment of experimental hyphema, subconjunctival hemorrhage, suppurative keratitis and dacryocystitis.

John J. Stern.

Badtke, G. **Modern theories of myopia.** Arch. f. Ophth. **153**:231-272, 1952.

This is a critical survey especially of the theories developed by Lindner, Lisch-Sondermann, Poos, Vogt, Scheerer and von Szily. Abnormal development and growth of the retina seems to the author the most important factor in the genesis of myopia. (2 figures, 30 references)

Ernst Schmerl.

Bagolini, B., and Leonardi, F. **Action of antibiotics on herpes virus.** Boll. d'ocul. **32**:65-68, Feb., 1953.

Terramycin, bacitracin, chloromycetine and virazene do not influence the course of experimental herpetic keratitis of the rabbit. Suspensions of herpes virus

obtained from dendritic keratitis and exposed, in vitro, to the aforementioned antibiotics produced experimental keratitis of almost identical severity and course as suspensions of the same concentrations not exposed to the antibiotics. (References) K. W. Ascher.

Belavia, M., and Pellegrino, F. **Vitamin B_{12} in ophthalmology.** Arch. di ottal. **56**:65-82, Jan.-Feb., 1952.

The stimulating action of vitamin B_{12} on the production and maturing of erythrocytes is well known, and the vitamin seems to be similar to, if not in part identical with, the animal protein factor. With this in mind, the author employed it systemically and locally in experimental corneal lesions of rabbits. The treated eyes healed faster by 25 percent than the controls.

In one case of fascicular keratitis in which the disease had not responded to atropine, penicillin and vitamin D_2 the lesions cleared within eight days with local and systemic applications of vitamin B_{12}. Similar highly satisfying results were obtained in one case of corneal abscess and five of eczematous keratitis.

John J. Stern.

Binder, R., and Binder, H. **The influence of heparin on the coagulation potential of the secondary aqueous.** Wien. klin. Wchnschr. **65**:75-76, 1953.

Coagulation of the secondary aqueous can be lessened or completely avoided in eyes of rabbits, if heparin is given in adequate dosage. Retrobulbar injection was the most effective mode of application. The authors speculate as to the possibility of avoiding the formation of membranes and synechiae in patients with uveitis by the use of heparin. (5 references)

Max Hirschfelder.

Bocci, G. **Penicillin and chloramphenicol sensitization of the conjunctiva.** Boll. d'ocul. **32**:8-12, Jan., 1953.

Twelve rabbits weighing 1,700 to 1,800 grams received preliminary antibiotic treatment for 16 consecutive days. Four animals received instillations of a penicillin ointment (1,000 units per gram) into the right eye; four more penicillin ointment (10,000 units per gram) and the remaining four, one-percent synthetic L-chloramphenicol ointment. One month after the last antibiotic administration, two animals of each group received analogous local treatment to both eyes on the same day for one single administration. The remaining two animals from each group received parenteral antibiotic injections; those with previous penicillin treatment were given intravenous injections of 10,000 units of penicillin, those treated with chloramphenicol locally received 0.125 grams of chloramphenicol subcutaneously. Conjunctival hyperemia observed in the previously treated eye only, most marked after penicillin, proved the presence of hypersensitivity to the antibiotics. No such reaction was observed after parenteral administration. The hypersensitivity was not due to anaphylactic allergy. (References)

K. W. Ascher.

Capalbi, S. **The antibacterial activity of neomycine in vitro on some pathogenic germs of the eye.** Arch. di ottal. **56**:475-481, Nov.-Dec., 1952.

A concentration of Neomycine of 5 Waksman Units per cc. inhibited totally in vitro the development of Escheridia coli, Bacillus enteridis, Staphylococcus aureus and albus, Streptococcus hemolyticus and viridans, Diplococcus pneumoniae, Klebsiella pneumonia, Moraxella lacunata and liquefaciens, and Hemophilus influenzae and pertussis. Against Bacillus subtilis it was effective only in a concentration of 15 W. U. per cc. John J. Stern.

Chingalia, V., and Franca, F. **Electrophoresis of the aqueous humor.** Rassegna ital. d'ottal. **21**:433-443, Nov.-Dec., 1952.

Employing filter paper and the electrophoretic technique, the author made comparative studies of the serum and the aqueous, emphasizing the protein globulin fractions. In 24 subjects, some normal and others with various ocular diseases, the albumin-globulin ratio of the aqueous and the serum is almost always diminished, with a nearly constant increase of the alpha-globulin fraction. (1 figure, 1 table, 28 references) Eugene M. Blake.

Dorello, Ugo. **Studies on the glutathione of the crystalline lens.** Rassegna ital. d'ottal. **21**:415-418, Nov.-Dec., 1952.

The simultaneous administration of ACTH and DCA has not demonstrated any modification of the content of glutathione in the lenses of rabbits, while in previous studies the two hormones, administered singly, showed a reduction of the tripeptide. This suggests the hypothesis that an antagonism exists between ACTH and DCA. (5 references) Eugene M. Blake.

Dorello, U. **The bacteriostatic activity of sodium propionate in conjunction with various pupillomimetic drugs.** Arch. di ottal. **56**:259-303, July-Aug., 1952.

In vitro experiments showed that atropine, homatropine, scopolamine, pilocarpine, eserine, adrenaline, dionine and farmocaine in therapeutic concentrations did not interfere with the bacteriostatic activity of sodium propionate. Occasionally it seems even to be enhanced, possibly because of a certain bacteriostatic effect of the drugs in question. John J. Stern.

Fujino, H. **A study of the bases of ophthalmic ointment and solution.** Acta Soc. Ophth. Japan **57**:225-229, May, 1953.

A ten-percent solution or ointment of sulfonamide was prepared with various bases and was instilled into rabbit eyes. The aqueous was examined for sulfonamide. A good resorption of sulfonamide into the aqueous was obtained when hydrophilic ointment, propylenglycol and carbowax 1,500 were used as the base. Petrolatum and glycerin base gave a poor resorption. A prolonged good resorption was obtained when carbowax was employed. Yukihiko Mitsui.

Gezurian, Lila Z. **Corneal epithelium: mitotic action of the lipotropic factors.** Arch. oftal. Buenos Aires **27**:450-451. Oct., 1952.

The lipotropic factors have a cytogenic action on the corneal epithelium of the normal guinea pig. The mitotic index of the layer of basal cells is about 2.17 percent, whereas 1.30 to 0.40 percent is normal. The mitotic index of the layer of spinous cells is about 2.38 percent, normal is 0.62 percent. Joseph I. Pascal.

Go, K. H. **Exudation and absorption mechanisms of the normal conjunctival capillaries.** Brit. J. Ophth. **37**:50-53. Jan., 1953.

This study adds toward the goal of understanding the physiology of corneal nutrition by describing some of the functions of the limbal capillaries. The end capillaries were examined with the slit-lamp while solutions of dionine, pilocarpine, histamine, adrenaline and atropine were instilled into the conjunctival sac. After dionine, the vessels became dilated and filled with blood, and continued so for 120 to 150 minutes. The reaction to histamine was similar and lasted 100 to 120 minutes. Pilocarpine resulted in increased blood flow through dilated vessels but after 30 to 50 minutes the effect had worn off. Adrenaline instilled with dionine inhibited its action appreciably while eserine, atropine, or cocaine with the dionine had almost no effect. The function of the vessels is governed by the vasomotor nerves and drugs which effect these nerves alter the function of the vessels directly. Morris Kaplan.

Hanabusa, J. **Toxin of Candida albicans.** Acta Soc. Ophth. Japan **57**:158-160, March, 1953.

Repeated instillation of heat-killed Candida albicans for six days resulted in a blepharo-conjunctivitis in two of the three volunteers. The author considers, therefore, that Candida albicans produces a heat-stable toxin. A single instillation of the toxin, however, did not result in any inflammation of the eye in five other volunteers. Yukihiko Mitsui.

Haruta, C., Minami, M., and Toshima, K. **Cholinesterase and acetylcholin of the iris.** Acta Soc. Ophth. Japan **57**:219-221, April, 1953, and Minami, M. **Effects of some medicaments on cholinesterase.** Ibid. **57**:243-251, May, 1953.

In the first report, the authors state that specific cholinesterase is extracted from the iris of cattle and rabbit. The concentration of the ferment in the pupillary zone of the iris is two to six times greater than that of the ciliary zone. The ciliary body contains only a small amount of the ferment. The distribution of acetylcholin in these tissues parallels that of cholinesterase. The authors wonder why the ciliary zone of the iris contains a relatively great amount of these substances, as this portion is believed to have a sympathetic nerve supply.

In the second report, the author states that the cholinesterase of the rabbit eye and serum is impeded 80 percent in its activity in vitro by DFP, prostigmin, eserine, benzyl-imidazoline and strichnine at a concentration of less than 1 mg./ml. In vivo, however, benzyl-imidazoline causes a mydriasis in the rabbit, while the other substances cause a miosis. The author discusses the mechanism of action of these medicaments on the pupil. He further states that human cholinesterase is extremely susceptible to DFP. DFP loses its potency rapidly in aqueous solution; about 99.5-percent lowering of potency results in one week.
Yukihiko Mitsui.

Kano, T. **Influence of testosterone on the retinal metabolism.** Acta Soc. Ophth. Japan **56**:810-815, Aug., 1952, and **57**:148-154, March, 1953.

In male rabbits a repeated injection of testosterone acetate and propionate, 0.05 mg. daily for one week, results in an increase in carbohydrate breakdown and aerobic glycolysis of the retina. An acetate is more effective than a propionate. In female rabbits the same injection results in a decrease of the retinal metabolism.
Yukihiko Mitsui.

Kawata, E. **Effect of mydriatic and miotic on the ciliary body of the rabbit.** Acta Soc. Ophth. Japan **57**:239-242, May, 1953.

Otsuka and his associate reported (Ibid. 54:182-185, 1950) that they recognized Brücke's fibers in the rabbit ciliary body, and that a hypertrophy and an atrophy of the ciliary body were brought about after a prolonged application of pilocarpine and atropine respectively. The present author reëxamined these results and states that he could not recognize any muscle fiber in the cilary body of the white rabbit and that no change was brought about in the ciliary body after a prolonged instillation of the drugs used by Otsuka. Yukihiko Mitsui.

Kojima, K., and Nagao, Y. **Polysaccharides in the retina.** Acta Soc. Ophth. Japan **57**:127-136, March, 1953.

The authors re-examined and evaluated the per-iodic acid method first reported by Hotchkiss (Arch. Biochem. 16:131, 1948) as a staining technique for glycogen and polysaccharides in the retina. They state that there are two kinds of positive reaction for this stain; namely, the red and the violet reaction. There are corpuscular

and diffuse substances in each as well as substances digested and not digested by saliva. The substance digestible by saliva may be considered as glycogen. The best staining can be obtained in sections fixed with alcohol. The authors consider that not only glycogen and polysaccharides but also some of the lipid may give rise to a positive result in this reaction.

They also describe the distribution of glycogen and polysaccharides in human and animal retinas. The data are tabulated in detail. In the human retina, the reaction is feeble in general. A relatively strong reaction is seen in the internal limiting membrane, the inner plexiform layer and the layer of nerve fibers. There are no glycogen granules but the test is positive for dust-like glycogen. The strongest reaction is seen in the outer part of the layer of rods and cones of the cat's eye.

Yukihiko Mitsui.

Langley, D., and MacDonald, R. K. **Clinical method of observing changes in the rate of flow of aqueous humor in the human eye. I. Normal Eyes.** Brit. J. Ophth. **36**:432-437, Aug. 1952.

This paper describes the technique of the fluorescein instillation test in the normal human eye. After the instillation, the concentration in the aqueous reaches a maximum in two hours, after which there is a slight but steady fall lasting 12 to 18 hours. Mydriatics and miotics had no effect on the fluorescein concentration except that twice eserine caused a fall in the concentration indicating it may cause a temporary increase in aqueous flow in normal eyes or facilitate the exit of aqueous. It was found that the presence of fluorescein in the aqueous does not influence the permeability of the blood-aqueous barrier to fluorescein. The concentration of fluorescein decreases slowly over a prolonged period in the normal eye because a steady state exists between the concentration of fluorescein in the cornea and in the aqueous, combined with a continuous flow of aqueous. In enucleated eyes it was found that, provided fluorescein has penetrated the cornea to the endothelium, a stagnant aqueous will allow a rapid rise in the concentration of fluorescein.

Orwyn H. Ellis.

Lepri, Giuseppe. **The penetration of neomycin into the interior of the globe when introduced locally or generally.** Rassegna ital. d'ottal. **21**:419-432, Nov.-Dec., 1952.

Neomycin, introduced by Waksman, and said to be effective against a vast number of gram-negative and gram-positive organisms, as well as the tubercle bacillus, was studied by Lepri. The antibiotic was administered intravenously, subconjunctivally, subcutaneously, and by instillation. Experiments demonstrated that neomycin possess a marked facility of penetration into the anterior chamber, more evident when given intravenously or subcutaneously. Details of the dosage and methods are given. (3 figures, 43 references)

Eugene M. Blake.

Lepri, G. **Antibacterial activity in vitro of isonicotinic hydrazide on some pathogenic germs of the eye.** Arch. di ottal., **56**:215-223, May-June, 1952.

Antibacterial action on 13 micro-organisms was obtained only in concentrations of the drug which were so high that its clinical use could not be envisaged.

John J. Stern.

Malatesta, C. **Chromatographic investigations of free amino-acids in the intraocular fluids, the lens and the blood of cattle. Part III. Free amino-acids of the lens.** Boll. d'ocul. **31**:762-764, Dec., 1952.

Malatesta illustrates the chromatogram of ox lenses showing leucin, valin, treonin (traces), alanin, glutamin, taurin, serin, glycin, glutaminic acid, phosphocholamin, asparatic acid, and phosphoserin.

K. W. Ascher.

Malatesta, A. **Chromatographic investigations of free amino-acids in intraocular fluids, the lens and the blood of cattle. Part IV. Comment on the free amino-acid levels found in the blood, in intraocular fluids, and in the lens.** Boll. d'ocul. **31**:765-768, Dec., 1952.

Illustrating the chromatogram of ox blood, the author compares these levels with data previously published on intraocular fluids and the lens. All amino-acids found in the blood can be identified in the aqueous humor with the exception of phosphocholamin, beta-alanin, prolin, and tyrosin. The last three are not found in the vitreous and in the lens. The following acids are present in the aqueous but not in the lens: lysin, arginin, alpha-amino-butyric acid, and phenylalanin. The author considers the possibility that, with larger quantities investigated, some of the apparently missing animo-acids may be encountered in the intraocular fluids or in the lens as well. The findings obtained in the vitreous suggest the possibility of a greater metabolic activity in the anterior part of the vitreous as compared to that part adjacent to the retina. In accordance with this assumption is the fact that the end products of carbohydrate metabolism accumulate in the posterior part of the vitreous (lactic acid). K. W. Ascher.

Marconcini, E. **Ocular antidotes: quinine monochlorhydrate and sodium chloride.** Arch. di otal. **56**:83-96, Jan.-Feb., 1952.

Intramuscular injections of quinine monochlorhydrate (1-percent solution) given for 12 days to rabbits, resulted in degenerative processes in the optic nerve as demonstrated by Marchi's stain. When a 2-percent sodium solution was given simultaneously in subconjunctival or retrobulbar injections, the degenerative process was much less pronounced.

John J. Stern.

Marisco, Vincenzo. **The possible thrombogenic action of antibiotics on the eye.** Arch. d'ottal. **56**:451-462, Nov.-Dec., 1952.

Twenty patients between 17 and 45 years of age with various vascular disturbances of the eye (hemorrhagic retinitis, thrombosis of the central vein, embolism of the central artery) had received penicillin at an earlier time for some reason or other. All of them showed a prothrombin time which was reduced to 10 to 18 seconds (normal: 15 to 25 seconds). The question arises whether there is a causal relationship between the penicillin treatment and the vascular disturbance. (18 references) John J. Stern.

Müller, H. K., and Kleifeld, O. **The absorption of radioactive phosphorus by the lenses of young and old rabbits.** Arch. f. Ophth. **153**:177-187, 1952.

The authors used the Geiger counter and studied in vitro the absorption of radio-active phosphorus by rabbits' lenses. Lenses of young animals showed a more rapid and increased intake than those of older rabbits. The process seemed to be associated with enzymatic reactions and was found to be inhibited by monoiodine acetate and cyanate. Differences of capsular permeability due to age could not be recognized. The intake of radioactive sodium or potassium showed no relationship to enzymatic processes. (2 figures, 10 tables, 10 references) Ernst Schmerl.

Nakanishi, K. **Effect of ultrasonic waves on the permeability of blood-aqueous-barriers.** Acta Soc. Ophth. Japan **57**:138-142, March, 1953.

A fuchsin solution was introduced intravenously into rabbits and the transportation of the dye into the aqueous humor was followed. When the eye was exposed to an ultrasonic wave of 550-kc. frequency, the blood-aqueous barriers became more easily permeable for the dye. The effect became greater with increasing

time of exposure until it reached the climax after a three-minute exposure. The maximum concentration of fuchsin in the aqueous was obtained about 50 minutes after the exposure. Yukihiko Mitsui.

Niedermeyer, Siegfried. **Pathophysiology of consensual vascular reactions of the eye.** Arch. f. Ophth. **153**:221-230, 1952.

The author produced a detachment of the choroid in one eye of rabbits and found a disturbance of the other eye with changes of vascular permeability. Blocking by drugs of the sympathetic innervation of the eye operated upon inhibited the reactions of the second eye. The role of consensual vascular reactions in sympathetic ophthalmia is discussed. (3 figures, 16 references) Ernst Schmerl.

Ogino, S. **Vitamin C and crystalline lens.** Acta Soc. Ophth. Japan **57**:161-163, March, 1953; Yamada, Y., Ditto, Ibid. **57**: 194-199, April, 1953; and Mishima, I., Ditto, Ibid. **57**:199-201, April, 1953.

A series of studies by these authors in collaboration is described. The first author reports that a needled rabbit lens loses the capacity of closing a lactone-ring of 2,3-di-keto-gulonic acid to produce dehydroascorbic acid and that of dehydrating mannose to produce mannonic acid in the course of three and six days respectively.

The second author reports that in guinea-pigs deficient in vitamin C, an injection of benzoquinone acetate results in the development of cataract. An administration of vitamin C or anthranilic acid can prevent the cataract development, while glutathione can not do so.

The third author reports that the vitamin C synthesis by the lens from mannose is impeded by malonic acid, but it can be restored by fumaric acid or by adenosine triphosphate. The synthesis is also impeded by 2,4-dinitrophenol, but it can be restored by adenosine triphosphate.

Yukihiko Mitsui.

Ohashi, K., and Hotta, T. **Blood pressure of the anterior ciliary vessels.** Acta Soc. Ophth. Japan **57**:170-172, March, 1953.

The authors re-examined the results of their previous report (Am. J. Ophth. 35: 884, June, 1952) and found some imperfections in the experiment. In the present report they correct the mistake of the previous report and state that the maximum and minimum blood pressure of the anterior ciliary artery is 93.7 and 44.3 mm. Hg respectively on the average and the venous pressure is 15.4 mm. Hg.

Yukihiko Mitsui.

Orsoni, Jose. **Contribution to the ocular manifestations of snake bite poisoning.** Arch. di ottal. **56**:285-293, July-Aug., 1952.

A man, 40 years of age, was bitten in the leg by Vipera berus. He was brought to the hospital three hours later in a state of collapse. At this time a divergent strabismus was observed. Cardiac stimulants and snake poison antiserum brought about quick recovery but a paralysis of the left internal rectus disappeared only after seven days. John J. Stern.

Redi, F., and Miglior, M. **Biochemical changes in preserved corneal tissue.** Rassegna ital. d'ottal. **21**:445-452, Nov.-Dec., 1952.

Little is known of the changes which develop in the cornea preserved for only a few days before transplantion, and the data which are recorded are mostly histologic. The authors' studies are concerned chiefly with the ozo-protein content but were not sufficiently conclusive to be of great value. It was clear that corneal tissue is best preserved when isolated from the globe and in conditions where there is the least modification of the aqueous-like fluid. Hydrization favors the disintegration of the protein scaffold and the autolysis of the protein itself. (2 tables, 23 references) Eugene M. Blake.

Redi, F., and Miglior, M. **The blood-aqueous barrier during streptomycin treatment.** Boll. d'ocul. **31**:727-734, Dec., 1952.

Using the methods of Huber and Amsler the authors studied the permeability of the unaffected eye of patients under streptomycin therapy for unilateral ocular tuberculosis. With an intake of one gram daily intramuscularly, streptomycin did not alter the blood-aqueous barrier of the normal eye. Abstracts of the records of five patients and three permeability graphs are reproduced. K. W. Ascher.

Rodger, F. C. **Experimental thiamin deficiency as a cause of degeneration in the visual pathway of the rat.** Brit. J. Ophth. **37**:11-29, Jan., 1953.

In this series of experiments rats were used in controlled pairs and fed diets quite adequate in all respects except that thiamin was lacking; the animals were closely examined at frequent intervals and, finally, daily. The most characteristic sign of chronic thiamin deficiency (in rats) is a diminution of the heart rate from the normal of 500 beats per minute to 300 beats. The animals were killed at various intervals but the length of the experiment was 180 days. The studies showed that the optic and sciatic nerve developed atrophy when the animal was fed an adequate carbohydrate diet with a thiamin level inadequate for health but sufficient to keep the animals alive for 180 days. The degeneration in the pathways consisted of a high degree of hyperchromatism and sclerosis of the retinal ganglion cells as well as of the cells in the dorsal nucleus of the lateral geniculate body. There was also a marked proliferation of the oligodendrocytes within the optic nerve and tract. The most important sign was the tortuosity, varicosity and fragmentation of the visual fibers especially in their central terminations. The myelin sheaths showed a patchy demyelinization with soft plaques in the sheaths and with irregularity of outline and ballooning. These changes were found to be reversible with administration of thiamin in most instances.

Morris Kaplan.

Rossetti, Dino. **Therapeutic results with thiosemicarbazone (TB I/698) in certain tuberculous affections of the eye.** Ann. di ottal. e clin. ocul. **78**:527-534, July, 1952.

Thiocarbazone, whether administered alone, with, or after streptomycin, para-aminobenzoic acid, and general therapeutic measures, was found to act favorably in certain cases of tuberculous keratitis, iridocyclitis, uveitis, neuroretinitis, chorioretinitis, and Jensen's juxtapapillary retinochoroiditis. No positive action was observed in other cases of retinitis and in recurrent hemorrhages into the vitreous. (References) Harry K. Messenger.

Rossetti, D., and Borio, G. **The hydrazide of isonicotinic acid in ocular tuberculosis and variations in the pathergic state.** Ann. di ottal. e clin. ocul. **78**:569-594, Aug., 1952.

The pathergic state of the patients thus treated showed a constant tendency to pleoergy and an increased degree of allergy despite a lowered sedimentation rate. The authors advance the hypothesis that the drug not only has a specific effect upon the immune mechanism, but also acts as a nonspecific stress-producing agent. (10 graphs, references)

Harry K. Messenger.

Vidal, F. **Preocular fluid and lipotropic factors.** Arch. oftal. Buenos Aires **27**:447-449, Oct., 1952.

Lipotropic factors possibly transform into phospholipoids the fatty acids, especially oleic acid, free cholesterol, esters of cholesterol, and neutral fats, which in pathologic conditions are found in the preocular cavity and fluids. They exert a protective, preventive and impeding ac-

tion on the accumulation of fatty substances, and accelerate in a spectacular way the disappearance of these substances. Joseph I. Pascal.

Weigelin, E., and Löhlein, H. **The blood pressure in the episcleral vessels of the eye in normal persons.** Arch. f. Ophth. **153**:202-213, 1952.

The authors used Seidel's method to determine the blood pressure in the episcleral vessels. This is practically the same procedure as described in Starling's textbook of physiology for the determination of the venous and capillary blood pressure. They report an average value for the minimum arterial pressure of 36.4 ± 0.68 mm. Hg. The standard deviation for a single measurement is given as ± 6.4 mm. Hg. The average value for the maximum arterial pressure is said to be 68.7 ± 1.1 mm. Hg. The standard deviation for a single measurement is given as ± 10 mm. Hg. The mean error of the method is given as ± 2.15 mm. Hg or more. These figures are abstracted here in detail to show the reader how meaningless it is to report standard deviations of average values. In this instance they appear to be smaller than the mean error of the method. The blood pressure within the episcleral veins is given as 9.6 mm. Hg. The blood pressure in episcleral arteries usually differs by not more than ± 4 mm. Hg from the diastolic pressure in the retinal arteries and by not more than ± 9 mm. Hg from the systolic retinal pressure. (2 figures, 7 tables, 14 references)

Ernst Schmerl.

Wyburn, G. M., and Bacsich, P. **Survival of retinal elements in subcutaneous homografts.** Brit. J. Ophth. **36**:438-443, Aug., 1952.

A report is made of an incidental finding of surviving retinal tissue during experiments with homografts of cornea. Anterior eye segments were implanted subcutaneously into another guinea pig and removed after 3 to 4 weeks. Surviving retinal elements were found. An interrupted row of ganglion cells remained. The rod and cone elements were replaced by a single row of low columnar cells probably from the nonpigmented epithelial cells of the pars ciliaris retinae by redifferentiation. Optic fibers, ganglion cells, inner plexiform layer and bipolar cells were present in some sections, which also showed a tendency to cyst formation. Areas of vigorous cell proliferation were found and termed "retinomata." A protection by the abundant mucoproteins of the cornea against host reaction to the retinal tissue was considered.

Orwyn H. Ellis.

Yamashita, K. **Polymyxin B in external infections of eye.** Acta Soc. Ophth. Japan **57**:202-204, April, 1953.

Polymyxin B ointment in a concentration of 1,000 U/gm. was as effective as 0.5-percent streptomycin ointment in infection with Hemophilus conjunctivae in 8 cases. In 15 cases of infection with Moraxella, the same ointment was also very effective, but a little inferior to terramycin. In infections with gram-positive micro-organisms, polymixin was definitely inferior to terramycin.

Yukihiko Mitsui.

Zintz, R., and Wagner W. **The treatment of experimental and human ocular tuberculosis with Neoteben.** Deutsche med. Wchnschr. **78**:433-435, March 27, 1953.

Neoteben (isonicotinacidhydrazid) has tuberculostatic action which exceeds that of PAS and streptomycin enormously. In this critical study this datum was confirmed and for the first time recovery from experimental tuberculosis of the uvea was brought about by the oral administration of a drug. In man the results were equivocal. F. H. Haessler.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Asher, H. **Suppression theory of binocular vision.** Brit. J. Ophth. **37**:37-49. Jan., 1953.

In 1760 du Tour expressed the opinion that there is no fusion of two images but rather that one of a pair of corresponding points suppressed the other. It is in support of this theory that the experiments herein described were carried out. Twelve different line diagrams are illustrated which can be seen stereoscopically when viewed through 3-diopter convex lenses held in the hand. Many combinations of fusion, binocular vision and depth perception can be thus illustrated. That suppression of some sort occurs is evident since in each picture a figure either suppresses the background or is itself suppressed by the background. This occurs in dissimilar images and must occur equally for similar images although no proof of this is found. It is rather well established by these diagrams that whenever there is disparity of a contour, then that contour and the area adjoining it on both sides in the one eye will suppress the corresponding points in the other eye. This contour of one part of the image may be dominant in one eye and that of another part may be dominant in the other eye.

Morris Kaplan.

Auricchio, G. **Centering of the lens surfaces during accommodation.** Boll. d'ocul. **31**:721-726, Dec., 1952.

Ten eyes of young, emmetropic subjects were studied during relaxed accommodation, accommodation of 1.5-diopter and of 7 diopters. The anterior and posterior angle alpha was measured, using Nordenson's technique. In all the eyes studied, both angles increased during accommodation, the anterior angle alpha more definitely. The anterior angle grew at 1.5-diopter accommodation while the posterior angle alpha showed an increase only at the 7 diopter accommodation. Table I shows the results in comparison with those of former investigators; table II represents all readings of the present study. K. W. Ascher.

Bottino, Carlo. **Retinal cytochrome oxidase and the light adaptation curve after a large dose of vitamin B_2.** Ann. di ottal. e clin. ocul. **78**:491-496, July, 1952.

The light threshold was found to be appreciably lowered in 12 soldiers each of whom had received a single dose of 50 mg. of riboflavin. A similar test with guinea pigs showed no change in the cytochrome oxidase of the retina. (References)

Harry K. Messenger.

Fry, G. A. **Research in accommodation and convergence,** Am. J. Optometry **30**: 169-176, April, 1953.

This is a non-statistical summary of work done at Ohio State University since 1935. Terms like accommodation, base line, and spectacle point are well defined. Convergence due to accommodation can be measured by tests of heterophoria in vision through minus spheres, and the ratio to diopters of accommodation has been called the accommodation-convergence (A.C.A.) ratio. This ratio was found to remain practically constant, decreasing slightly at older age levels. Evidently no more innervation is required to produce a given change in accommodation at one age level than at another, although the amplitude of accommodation decreases with age. There is considerable variation in A.C.A. ratio in normal individuals, but no specific changes in strabismus. Convergence does not have as definite an effect on accommodation. P. W. Miles.

Glees, M., Rochels, K. H. and Wüstenberg, W. **Can the light and color sense of**

the normal subject be affected by vitamins and similar substances? Arch. f. Ophth. **153**:188-201, 1952.

Contrary to several other reports, the authors were unable to find any significant changes of the light sense and color vision in the normal subject when the preparation "Helenien" or vitamins A and C were administered. (6 figures, 3 tables, 5 references) Ernst Schmerl.

Hoff, H., and Seitelberger, F. **The restitution of the ability to see after corneal transplantation.** Wien. klin. Wchnschr. **65**:45-47, 1953.

A patient who had been blind since the age of two years regained his sight through corneal transplantation 30 years later. The restitution of the ability to see went through several phases over a period of four to five weeks. The first phase was a continuation of his custom to "see with his hands" by touching the object. He then progressed to recognizing his hand and certain objects which, at first, seemed to float. During a third phase moving objects in the central field of fixation seemed to be anchored in space, and the central impressions were seen successively in the sense of a stroboscopic polyopia. In a later stage single objects were properly seen, but the correlation of associated optical impressions, like the correct interpretation of pictures which told a story, was still difficult. The various steps in acquiring functional seeing ability are comparable to those of the physiological maturing of sight in infancy. They also resemble the recessive symptoms of cerebral blindness, as can be observed after injury penetrating the occipital lobe. The electroencephalogram was normal before the corneal transplant was performed. Marked irregularities with dysrhythmic waves followed removal of the bandages and the encephalogram of the occipital lobe again resembled the one of an infant. Normalcy of the EEG returned after four weeks. (8 references)

Max Hirschfelder.

Knoll, H. A. **The measurement of oblique astigmatism in ophthalmic lenses.** Am. J. Optometry **30**:198-201, April, 1953.

The expected astigmatism of oblique pencils and astigmatism from a pantoscopic tilt was measured roughly by a modified lensometer. P. W. Miles.

Knüsel, O. **The corneal contact lens (Tuohy).** Schweiz. med. Wchnschr. **83**: 314-315, March 28, 1953.

This truly floating lens which is never anchored to a point on the conjunctiva or cornea, is discussed in detail for the Swiss ophthalmologists who should at least be aware of a lens that is worn by more than 75,000 Americans. The most difficult step in fitting this lens is the determination of the proper relationship between the radius of curvature of the cornea and that of the corneal contact lens. It is not to be expected that this lens will replace spectacles any more than the standard contact glass will. All of these dioptric devices have certain indications. Fitting the corneal contact lens requires great patience on the part of the ophthalmologist and patient alike, and experienced American physicians find that 20 percent of applicants are found unsuited to contact glasses of any kind. F. H. Haessler.

Miles, P. W. **Depth of focus and amplitude of accommodation through trifocal glasses.** A.M.A. Arch. Ophth. **29**:271-279, March, 1953.

The ranges of clear vision through multifocal glasses are derived from 1. effort-free accommodative tone, 2. true active accommodation, 3. depth of focus, and 4. suppression of blur fringes. These factors were studied on 25 presbyopic patients. Asthenopia in presbyopic patients is

caused principally by induced heterophoria rather than too much add. Higher adds can be tolerated if accompanied by base-in prism. This study minimizes the importance of active accommodation in presbyopia. Small reading adds of plus .50 and trifocals with low intermediate adds of plus .62 are considered valuable aids to reading comfort. Plus 2.25 and plus 2.50 adds should be used only in patients with working distances of less than 40 cm. G. S. Tyner.

Robinson, H. M. **An analysis of four visual screening tests at grades four and seven.** Am. J. Optometry **30**:177-187, April, 1953.

The following tests were adapted for use with children: Eames, Keystone Visual Survey, Massachusetts, an adapted Ortho-Rater. Approximately 200 patients were tested thoroughly, and retests made for repeatability. Validity of the tests was studied by comparison with refractive findings. The tests failed to show any relation to progress in reading, unless they included binocular functions.

P. W. Miles.

Roos, W. **Definition of punctual imagery of spherical lenses.** Arch. f. Ophth. **153**:378-386, 1952.

Roos replies to a discussion by Kuehl which deals with a publication of the author, an abstract of which appeared in volume 35, p. 1226, Aug., 1952.

Ernst Schmerl.

Rosenberg, R., Flax, N., Brodsky, B., and Abelman, L. **Accommodative levels under conditions of asymmetric convergence.** Am. J. Optometry **30**:244-254, May, 1953.

This is a well planned experiment using stigmatoscopy and the three target haploscope. It differs from previous experiments in the literature in not stimulating monocular accommodation by minus sphere, or paying attention to side arm targets. Instead, in this experiment, binocular attention on a fine target requiring foveal vision is maintained, while accommodation for each eye is measured separately by superimposed stigmatoscopy, from the side arms. The binocular target on a frontal plane 20 centimeters from the eyes was moved to asymmetrical positions 12 and 20 centimeters lateral in each direction. Results on two normal individuals showed that the nearer eye did accommodate more with a lag in oblique gaze from theoretically perfect amounts of only about 0.3 diopters. This work should be repeated in various types of ametropia and in anisometropia.

Paul W. Miles.

Smelser, G. K., and Ozanics, V. **Structural changes in corneas of guinea pigs after wearing contact lenses.** A.M.A. Arch. Ophth. **49**:335-340, March, 1953.

Stromal swelling and rapid exhaustion of the glycogen stores of the corneal epithelium were demonstrated in guinea pig eyes after the use of contact lenses. The rapidity of onset of "Sattlers veil" in the guinea pig paralleled that in man. The water imbibed by the cornea was found to be between the fibers throughout the entire cornea. This disturbance of the normal arrangement of fibers and refractive index explains the corneal haze induced by contact lenses. These studies may indicate that the oxygen supply to the cornea is cut off by contact lenses, and glycogen depletion results from the necessity for anaerobic metabolism. G. S. Tyner.

Yuguchi, K. **Lability of the near point.** Acta Soc. Ophth. Japan **57**:208-218, April, 1953.

After continued close work at the near point, the near point is apt to be closer, i.e. the power of accommodation increases, in the majority of cases, especially in myopic eyes. The change in the accommoda-

tive power is the greatest after five minutes' work. After close observation of a rhythmically moving test object through a range of 30 cm., a change in the accommodative power results, an increase in some cases and a decrease in others, depending upon the conditions of observation. Yukihiko Mitsui.

Zinnecker, K. S., and Ellerbrock, V. J. **An investigation of the factors affecting the field of fixation through multifocal lenses.** Am. J. Optometry **30**:202-209, April, 1953.

Except for an accidental misquotation from Traquair, this paper is an excellent discussion of the size of the visual fixation field through the segments of multifocal lenses. The size can be computed for variations due to dioptric power, distance from the eye, working distance, and the diameter of the pupil. P. W. Miles.

5

DIAGNOSIS AND THERAPY

v. Beuningen, E. G. A. **A pyramidal gonioscope.** Klin. Monatsbl. f. Augenh. **122**:172-178, 1953.

This gonioscope is a quadrilateral pyramid of glass screwed into a plastic speculum. No contact fluid is necessary. It has four mirrors and no rotation is necessary. Frederick C. Blodi.

Bishop, J. W. **Appliance: portable refraction outfit.** Brit. J. Ophth. **36**:586-587 Oct., 1952.

A handy, portable refraction outfit is described and pictured. The illumination is by battery and is built into the lid of the case. The test type, mirrors and lenses are readily accessible. Orwyn H. Ellis.

Bruna, F. **Intraocular hemorrhages following the rupture of an intracranial aneurysm (Terson's syndrome of oculocerebral hemorrhage).** Boll. d'ocul. **31**:735-751, Dec., 1952.

Commenting on the case of a 40-year-old farmer, well illustrated by arteriographic reproductions (two figures) the author discusses extensively the theories proposed to explain the intraocular hemorrhages which often occur after the rupture of a basal aneurysm. These preretinal or vitreous hemorrhages in one or in both eyes may be of diagnostic value, particularly if the cerebral spinal fluid proves to be free of blood. The location of such hemorrhages suggests the side of the endocranial aneurysm. K. W. Ascher.

Burian, H. M. **Electroretinography and its clinical application.** A.M.A. Arch. Ophth. **49**:241-256, March, 1953.

A new contact lens-like electrode is described for use in electro-retinography. The results of a two-year study of normal and pathologic eyes are reported. The author's technique is described in detail. Some differences in the normal retinogram were obtained by this technique in comparison to standard techniques. The author believes the a-wave is connected with cone function. Thus far electroretinograms have been largely indicative of rod function. In patients with advanced glaucoma, the b-wave is normal, which indicates the block of the impulse is in the neural pathways. In the future electroretinography should prove an important means of investigating the function of the optic pathways.

G. S. Tyner.

Chinaglia, V., and Foroni, O. **Local application of cortisone in ophthalmology (clinical results).** Ann. di ottal. e clin. ocul. **78**:535-550, July, 1952.

The authors treated 65 cases of various eye diseases with cortisone. Brilliant results were obtained in vernal conjunctivitis, acute and subacute iritis and iridocyclitis, rheumatic scleritis, phlyctenular keratoconjunctivitis, and in certain cases of keratitis. Little or no improvement was

noted in posterior uveitis, exudative retinitis and choroiditis, glaucoma, hypertensive optic neuritis, and diseases of the vitreous. (References)

Harry K. Messenger.

Couadau, A., and Campan, L. **Anesthesia and ophthalmic surgery. A critical study.** Arch. d'opht. **12**:757-770, 1952.

The authors note that general anesthesia, particularly intravenous anesthesia with barbiturates, is being used with increasing frequency, especially by American surgeons. They analyze in detail the various types of anesthesia according to four criteria of usefulness, as follows: 1. simplicity; 2. anesthetic value; 3. safety; and 4. contribution to surgical efficiency. They conclude that general anesthesia is undesirable in ophthalmic surgery, except in children or in extremely painful procedures, for the following reasons: 1. it is more complicated than local anesthesia; 2. it provides unnecessary depth of anesthesia; 3. it involves unnecessary risk, particularly in aged, obese, and emphysematous subjects; and 4. it sometimes hampers the surgeon. The authors state emphatically that general anesthesia has no place in cataract extraction, and that local anesthesia combined with curare is far superior. Phillips Thygeson.

Esposito, A. C. **Modification of Bell's erisophake.** Brit. J. Ophth. **37**:61, Jan., 1953.

The Bell erisophake is modified by placing a B.D. syringe adapter between the metal tip and the rubber bulb. This serves to add length and weight to the instrument and gives it more maneuverability. Morris Kaplan.

Ferrara, Aristide. **Clinical and ophthalmometric studies of the "line of the palpebral margin."** Ann. di ottal. e clin. ocul. **78**:559-568, Aug., 1952.

Handmann described a horizontal linear reflex sometimes seen with the ophthalmoscope and attributed to pressure of the upper lid upon the cornea. In a study of patients in whom this line was observed Ferrara found corneal irregularities which consisted essentially in an increase of curvature along the vertical meridian 12° to 16° from the center of the pupil and a rapid diminution of curvature more peripherally above. (References)

Harry K. Messenger.

Heinz, K. **The problem of hemorrhage in eye surgery.** Wien. klin. Wchnschr. **65**: 53-55, 1953.

Expulsive hemorrhage in people with vascular hypertension and fragility of the vessels is one of the dangers still present in modern cataract surgery. The value of venesection immediately before surgery is questionable. New drugs act on the ganglia and bring about a most drastic reduction in blood pressure. 50 to 200 mg. of the Ciba preparation Pendiomid injected intravenously lowers the blood pressure 100 mm. Hg and more. The decrease in pressure can be controlled by slow and sometimes intermittent injections. All the patients were operated upon under local anesthesia and did not feel any untoward effect of the drug. The author has so far not had any mishap, but final judgment must be postponed until a larger number of cases have been observed.

Max Hirschfelder.

Klar, J. **Determination of blood pressure in pulseless persons by ophthalmodynamometry.** Wien. klin. Wchnschr. **65**: 58-59, 1953.

The definite and constant relation existing between the blood pressure in the brachial and in the retinal arteries will aid in the determination of blood pressure. Ophthalmodynamometry was used in a man with severe aortic stenosis in whom the blood pressure could not be deter-

mined by the usual means. (3 references)

Max Hirschfelder.

Krümmel, H. **A new endpiece for the giant magnet.** Klin. Monatsbl. f. Augenh. **122**:344-349, 1953.

The endpiece is attached to a ball joint. This facilitates the management of the rigid giant magnet when using it for diascleral extraction of a foreign body. The author describes seven cases in which this attachment proved to be of advantage. (3 references, 1 figure)

Frederick C. Blodi.

Laval, J., and Coles, R. S. **Role of cortisone in glaucoma surgery.** A.M.A. Arch. Ophth. **49**:168-181, Feb., 1953.

The effects of cortisone on wound healing when administered subconjunctivally and systemically are compared. Subconjunctivally administered cortisone had a negligible effect on wound healing, whereas intramuscularly administered cortisone produced a rather marked delay. Pre- and postoperative systemic cortisone may be a valuable aid in filtering operations for glaucoma. G. S. Tyner.

Lepri, Giuseppe. **Influence of cortisone on the course of experimental ocular tuberculosis and of tuberculosis attenuated by treatment with streptomycin.** Ann. di ottal. e clin. ocul. **78**:551-558, July, 1952.

Four groups of rabbits in which ocular tuberculosis of the human variety had been induced by inoculation into the anterior chamber were treated respectively with cortisone, saline solution, streptomycin plus cortisone, and streptomycin alone. It was found that the intensity of the tuberculous reaction was essentially the same whether the animals received cortisone or not. (References)

Harry K. Messenger.

Lijó Pavía, J. **Retinography in color. A new product: Ektachrome.** Rev. otoneuro-oftal. Sud-am. **27**:123-127, Nov.-Dec., 1952.

The author reviews different materials used in color retinography. In Argentina the difficulty with Kodachrome pictures is due to the fact that developing is done only in the United States. With the technical assistance of a professional photographer the author analyzes the new product, Ektachrome, and describes in detail the properties and developing of this product, with which he has obtained good retinograms. (3 references)

Walter Mayer.

Marin Amat, M. **Local application of cortisone in ophthalmology.** Arch. Soc. oftal. hispano-am. **13**:121-139, Feb., 1953.

A review of the literature is followed by brief reports of 22 cases in which cortisone was used by instillation or subconjunctival injection. The author concludes that cortisone has a predilection for mesenchymal tissues, and that its effect is nonspecific and chiefly antiphlogistic. Its use is compatible with mydriatics and miotics but there seems to be no reason for using it in combination with antibiotics. It is most beneficial in allergic and traumatic disorders of the conjunctiva and the anterior ocular segment. It is of no value in chronic diseases, dystrophies, degenerations, and cicatricial processes. In some allergic conditions, such as spring catarrh, its action is transitory. It is contraindicated in infectious processes and virus diseases, such as dendritic keratitis. Its effect is also unfavorable in lesions with a hemorrhagic tendency.

Ray K. Daily.

Miller, A. J. H. **Elschnig's capsulo-iridectomy.** Brit. J. Ophth. **36**:444-446, Aug., 1952.

The author comments on Elschnig's capsulo-iridectomy and shows the procedure clearly with illustrations. It is

recommended that the knife incise the iris-capsule diaphragm after the primary incision is complete. The operation is recommended as a safe, easy procedure for post-operative occlusio pupillae.

Orwyn H. Ellis.

Mitsui, Y., and Yamashita, K. **Hydrocortisone in ophthalmology.** Acta Soc. Ophth. Japan **57**:165-167, March, 1953.

In 11 cases of scleritis, sclerokeratitis, interstitial keratitis and iridocyclitis, in 8 of which the patient had been treated with cortisone with little benefit, 0.2 cc. of 0.5-percent hydrocortisone acetate were given subconjunctivally. In 9 of the 11 patients it showed an excellent, and in the other two a good effect. In scleritis only an injection at the site of the inflammation gave an excellent result.

Yukihiko Mitsui.

Nueffer, T. **A new adjuvant for electrosurgery.** Klin. Monatsbl. f. Augenh. **122**: 208-209, 1953.

A horizontal metal tube is suspended over the operating table in a gallows-like arrangement. In this tube the various cables are brought to the operating field. They are covered by a sterile cloth and are easily accessible.

Frederick C. Blodi.

Rapisarda, Dante. **Cortisone by local application in ocular therapy.** Ann. di ottal. e clin. ocul. **78**:459-468, July, 1952.

Rapisarda treated 51 patients with 1-percent cortisone applied locally in an ointment or in an aqueous suspension. The best results, sometimes quite astounding, were obtained in anterior uveitis, particularly postoperative, also in keratitis profunda, simple herpes of the cornea (but not in dendritic keratitis), congenital luetic interstitial keratitis, pannus trachomatosus resistant to other forms of treatment, and keratoconjunctival manifestations of tuberculosis. The local application, especially in the form of ointment, meets most of the requirements of the ophthalmologist. Other routes are indicated only in cases of exceptional severity or when the posterior pole of the globe is involved. (References)

Harry K. Messenger.

Scheie, H. G. **Evaluation of ophthalmoscopic changes of hypertension and arteriolar sclerosis.** A.M.A. Arch. Ophth. **49**:117-138, Feb., 1953.

The various types of arteriosclerosis occurring in the body are classified and described. Of six entities mentioned, only two, atherosclerosis and arteriolarsclerosis are commonly recognized with an ophthalmoscope. The two conditions represent distinct and separate clinical entities. In the the eye atheromatous plaques occur only in the central retinal artery or its main branches near the disc. The actual plaques are often invisible because of their location within the optic nerve at the level of the lamina cribrosa. When so placed the presence of a plaque may be manifest by narrowing of the arterial tree and an increased number of branches at the disc borders. Lesions at or near the disc may appear as a white or opaque area in the wall of the vessel or merely a localized irregularity of the blood column. The commonest clinical manifestations of this disease are vascular accidents, such as occlusion of the central retinal artery or one of its branches, or occlusion of the central retinal vein due to pressure of the plaque on the vein in the common adventitial sheath.

Arteriolar sclerosis is the result of the stress and strain of hypertension on the arterioles. It occurs uniformly in the arterioles throughout the body. The ophthalmoscopic signs of arteriolar sclerosis are widening of the light streak, "copper-wire" arteries, "silver-wire" arteries, A-V crossing defects and tortuosity of the small vessels near the macula.

The ophthalmoscopic changes of hypertension may appear alone or in combination with various degrees of arteriolar sclerosis, depending on the severity and duration of the disease. They are narrowing of the retinal arterioles, irregularity in vessel caliber, hemorrhages and exudates and edema of the disc and retina.

The author proposes a system of grading the signs of hypertension and arteriolar sclerosis separately. Each is graded separately because the hypertensive changes indicate severity of the hypertensive process and the changes of arteriolarsclerosis reflect organic damage to the arterioles by the wear and tear of hypertension, thus indicating duration of the disease. G. S. Tyner.

Straub, Wolfgang. **Contribution to the method of electroretinography.** Arch. f. Ophth. **153**:214-220, 1952.

The author uses contact glasses with platinum wires as eye electrodes and a somewhat modified electro-encephalograph. (5 figures, 15 references)
Ernst Schmerl.

Wachtler, F., and Zdansky, E. **Indications for irradiation in ophthalmology.** Wien. klin. Wchnschr. **65**:49-51, 1953.

Treatment by irradiation plays an important part in ophthalmology. Eye cases constituted 5 to 10 percent of all cases treated by irradiation in the central X-ray institute of the University of Vienna during the past few years. Treatment of retinal gliomas by means of radon seeds is more promising than was at first assumed. Beta ray irradiation of conjunctiva and cornea destroys vascularized and inflammatory lesions. X-ray treatment had a seemingly beneficial effect in cases of herpetic keratitis, corneal ulcer, and phlyctenular keratoconjunctivitis. It also proved useful in various conditions of the conjunctiva such as vernal catarrh and Parinaud's conjunctivitis. Epiphora may be combated by X-ray treatment of the lacrimal gland. The use of X-ray irradiation in cases of iritis and choroiditis, especially those of a granulomatous nature, has been beneficial in as high as 75 percent of the cases. Useful, but somewhat less satisfactory effects are found after X-ray treatment of far advanced painful glaucoma and after intraocular hemorrhages of various cause. Neoplasm of the lids and the limbal region can be destroyed by irradiation, while in primary melanomas of the uvea pre- and postoperative irradiation is merely the adjuvant to surgical removal of the eye. Metastatic tumors of the bulbus demand deep X-ray treatment. Similar treatment can be considered for benign orbital tumors, especially hemangiomatas and lymphangiomatas. The dosage in treatment of inflammatory eye conditions is usually too small to damage the lens. Deep X-ray therapy for intraocular malignancy usually leads to cataract and, sometimes, to iritis with secondary glaucoma. (33 references) Max Hirschfelder.

Wessely, K. **The role of X-ray stereoscopy in ophthalmology.** Arch. f. Ophth. **153**:371-377, 1952.

Several illustrations emphasize the importance of X-ray-stereoscopy. (7 figures)
Ernst Schmerl.

Woods, Alan C. **Uses and limitations of ACTH and cortisone in ophthalmology.** Brit. J. Ophth. **36**:401-430, Aug., 1952.

As more information is gained about the effects of ACTH and cortisone it is important to know the therapeutic application, limitations and contraindications. The broad principles are becoming clear: the action is not curative; it is limited to a control of the exudation and inflammatory phases, which is not always desirable. In the allergic reactions these hormones reach their highest usefulness. In acute nonbacterial inflammations of the external eye the results are usually spectacular.

Even drugs causing dermatitis, such as atropine, can be used as long as the hormonal treatment is continued. If no adequate accessory therapeutic procedures are available, then the natural pattern of the disease and defense mechanism had better not be unduly disturbed. In acute non-granulomatous uveitis the effect of ACTH and cortisone is usually excellent and consistent. In the chronic form the inflammation tends to recur after cessation of treatment. Cases of granulomatous uveitis in the acute form are usually controlled but relapses are frequent and usually the underlying cause is unaffected. Sympathetic disease may often be controlled with prolonged therapy. Some inflammations of the nerve and retina respond to hormonal therapy, many, such as the hemorrhagic types, do not. Degenerative diseases in general show little response but control of the edematous and inflammatory phase may give comfort and improve vision. The dosage and methods of administration are clearly detailed, parenterally, orally and topically. Experimental studies show that topical or parenteral cortisone or ACTH will suppress ocular hypersensitivity reactions, suppress ocular reactions to irritants, suppress inflammation due to infection, inhibit neovascularization of the cornea and reduce fibroblastic activity in the stroma of the cornea and regeneration of the corneal endothelium. Cortisone and Compound F may change the picture in the immune allergic rabbit from a restrained fibrotic process to a necrotizing caseating destructive lesion with great increase in the numbers of bacilli in the lesions. The contraindications, side effects and conditions with generally unfavorable reactions are described in detail. The specific mode of action is undetermined but it is suggested that these drugs act at the cell level through some as yet unknown action upon the mesenchymal tissue.

Orwyn H. Ellis.

Yokoyama, K. **A serologic study of ocular tuberculosis.** Acta Soc. Ophth. Japan **57**:180-194, April, 1953.

In 100 cases of various tuberculous conditions of the eye, some serologic reactions were examined. Data are summarized in 11 tables. Middlebrook-Dubos' hemagglutination was positive in 34 percent of the cases. The complement fixation reaction, using protein and phospholipin of tuberculous bacilli as the antigen, was positive in 20 and 19 percent of the cases respectively. The precipitation reaction using polysaccharides of the bacilli as the antigen was positive in 19 percent of the cases. The first reaction was positive in all cases in which at least one of the other reactions was positive. The author states that these figures are considerably lower than those obtained in pulmonary tuberculosis. He further states that the tuberculin reaction and the sedimentation rate of red blood cells have no relation to the positivity of these serologic reactions.

Yukihiko Mitsui.

Zettel, J. **A possible way to extend the use of the perimeter.** Am. J. Optometry **30**:188-197, April, 1953.

The standard perimeter was modified by means of a mirror instead of an occluder before one eye, to form a haploscope. It was especially well adapted for measuring the central scotoma of the deviating eye in strabismus, while fixation remained constant in the other. Orthoptic measurements of the subjective and the objective angles of squint were readily made. It also could function as a stereocampimeter.

P. W. Miles.

6

OCULAR MOTILITY

Dor, L. **Paralysis of divergence.** Arch. d'opht. **12**:771-773, 1952.

Dor strongly supports the theory that paralysis of divergence is an entity and

cites the findings in three cases to substantiate his opinion. He then reviews in detail the arguments for and against this concept and concludes that it would be most unlikely for the movement of the eyes to be an exception to the laws governing the movements of all other movable parts of the body.

Phillips Thygeson.

Foroni, C. **Operation for concomitant strabismus.** Ann. di ottal. e clin. ocul. **78**: 875-880, Oct., 1952.

Foroni describes his operation which may be best understood from a study of the illustrations. Harry K. Messenger.

Manzitti, E., and Nicoli, C. **Lloyd's operation on the inferior oblique.** Arch. oftal. Buenos Aires **27**:297-301, July, 1952.

The following technique is described. Section of the conjunctiva is made in the lower-outer quadrant, opening the capsule of Tenon. If it is necessary to do a myectomy of the external rectus, the muscle is grasped and cut at the level of its insertion, and let go in order to execute recession of the inferior oblique. If a myectomy is not necessary, the external rectus is grasped with a strabismus hook and the eyeball rotated upward and inward in order to locate the inferior oblique. Where the insertion of the external rectus has been severed, what is left of the insertion is grasped with pincers and the globe rotated in the same way. A strabismus hook inserted in the wound, flush with the sclera, will bring up the inferior oblique, which is freed from its capsule and followed to its scleral insertion. Here two catgut sutures are placed at the very end, after which the muscle is cut flush with the sclera. The end of the muscle is carried to its new place of insertion as determined previously, the two ends of the catgut are passed separately through the outer layers of the sclera and tied together. If a myectomy was necessary, it is now repaired. Otherwise the external rectus is freed from the hook which held it. The conjunctiva is then closed with a continuous suture. Joseph I. Pascal.

Ogle, K. N., and Prangen, A. deH. **Observations on vertical divergences and hyperphorias.** A.M.A. Arch. Ophth. **49**:313-334, March, 1953.

The authors found by their method of testing that the majority of subjects have the ability to compensate for vertical divergences exceeding six diopters. The possible compensatory mechanisms are discussed. G. S. Tyner.

Ohm, J. **Frequency, the most important quality of miners' nystagmus.** Arch. f. Ophth. **153**:321-332, 1952.

The author feels that the frequency of oscillation is governed by certain centers for the ocular movements. With improved working conditions an increase in frequency is said to develop. (8 figures, 1 table) Ernst Schmerl.

Rama, Giovanni. **Horizontal divergence due to convergence paralysis.** Riv. otoneuro-oftal. **26**:215-221, May-June, 1951.

The author reports a case of sudden onset of hemiplegia and diplopia. The patient recovered fairly well except for the diplopia. At the time of examination he had a divergent squint of 25° and convergence paralysis. A bilateral advancement of about 10 mm. (!) of both medial recti was performed. The result was binocular single vision from infinity to 40 cm. from the eye. The author thinks that the surgical intervention may have caused an overcorrection counterbalanced and regulated by an active divergence. He thinks that this may be proof of the existence of an independent function of divergence. (22 references)

Bruno S. Priestley.

Urrets Zavalia, Alberto. **Etiopathogenesis of concomitant strabismus.** Arch. oftal. Buenos Aires **27**:329-355.

The strabismus of an ophthalmoplegic type, of early appearance, presents itself usually as an accentuated horizontal deviation, even though it is almost always the result of a vertical imbalance, and is accompanied by serious sensorial anomalies. Surgical treatment, although practised at an early stage, ordinarily results in nothing more than cosmetic improvement. Orthoptics is generally ineffective. In certain cases, however, the foveal fixation reflex makes possible the projection onto the foveae of the image perceived by each eye of an object which attracts attention; binocular vision develops then, and the deviation manifests itself intermittently. The treatment consists in reëstablishing motor equilibrium, and in improving the fusional amplitude. The strabismus of an anisesthetic type is a consequence of the disparity of the retinal images resulting from dioptric obstacles (opacities of the refractive media, strongly asymmetric refractive anomalies, aniseikonia) or from lesions of the retina or the optic nerve. The prognosis in this case depends on the nature of the determining factor and the possibility of its correction. Treatment must aim in the first place toward the disappearance of the anisesthesia, and must also be surgical and orthoptic. The strabismus that is primarily accommodative appears about the age of two years and thereafter. Total correction of the existent ametropia (which ordinarily suffices for straightening of the ocular axes whenever the deviation is still periodic), occlusion (when amblyopia is present, surgical operation, if the deviation has already become permanent), and pre- and post-operative orthoptic training are indicated.

The classification outlined includes the fundamental forms as well as the intermediate ones due to the superimposed action of several etiologic factors. Some encephalic alterations and certain craniofacial anomalies can evidently give rise to squint; in such cases, however, the ocular disturbance is only a secondary phenomenon. Joseph I. Pascal.

7

CONJUNCTIVA, CORNEA, SCLERA

Alagna, G., and Recupero, E. **The medullary and peripheral blood picture in spring catarrh.** Arch. di ottal. **56**:269-284, July-Aug., 1952.

Quantitative and morphological study of the peripheral blood in 11 patients with spring catarrh showed a moderate degree of hypochromic anemia without signs of blood regeneration, leucopenia (relative neutrophilia) manifest eosinophilia, increase of the monocytes (relative lymphocytosis), and a moderate fall of the platelet count. Sternal puncture revealed an increase in promyelocytes. The granulocytes were decreased in two-thirds of the cases, normal or increased in one third. Mature and immature eosinophiles were always increased. The erythroblastic series showed polychromatophilia. Promegacaryocytes and megacaryocytes were slightly inhibited. These findings are comparable to those in allergic conditions and do not contribute to the solution of the question of hormonal and neuro-vegetative factors in the etiology of the disease. John J. Stern.

Angelone, Luigi. **Chloramphenicol in the treatment of herpetic disease of the cornea.** Rassegna ital. d'ottal. **21**:513-536, Nov.-Dec., 1952.

Chloramphenicol has a marked bactericidal action, is effective in the presence of organic fluids, is tolerated in doses sufficient to control infection, aids cicatrization, and reduces the toxicity of the virus in corneal herpes. The duration of herpetic keratitis was reduced from many weeks to 10 to 15 days in 10 cases reported. No patient treated failed to show some improvement when this antibiotic was used. There were no signs of incompatibility with

other chemotherapeutic substances, sulfa drugs or vitamins, except that penicillin appeared to retard the treatment. Chloramphenicol is advised for treatment in virus infections in general. (10 colored figures, 55 references) Eugene M. Blake

Babel, J., and Bourquin, J. B. **Experimental research with corneal heterographs.** Brit. J. Ophth. **36**:529-536, Oct., 1952.

Heterografts from various species were placed interlamellarly in the rabbit cornea. Many of these remained clear for the period of observation (three and one-half months) with no inflammatory, edematous or vascular reaction. The endothelium showed no manifest signs of activity but the epithelium proliferated and exhibited strong vitality. Some grafts became opaque, and edema of the stroma and pannus-type vascularization were present in the recipient. The reaction usually begins on the fifth to the twelfth day. In two animals the corneal injection of trypan blue checked the edematous reaction in the recipient. In a few cases the reaction was so severe that the graft was completely invaded and destroyed by the host.

Bilateral heterografts almost all became opaque, the reaction beginning between the fifth and tenth day. Approximately half the heterografts were successful; the others induced a defense reaction in the recipient eye. It has not been determined that the transparent homografts are living. The graft in the second eye apparently produced an anaphylactic reaction to the corneal tissue itself.

Orwyn H. Ellis.

Berliner, M. L. **Cornea and sclera.** A.M.A. Arch. Ophth. **49**:222-236, Feb., 1953.

The pertinent literature from October, 1951, to October, 1952, is reviewed.

G. S. Tyner.

Chinaglia, V. **Marginal degeneration of the cornea.** Ann. di ottal. e clin. ocul. **78**: 497-526, July, 1952.

Chinaglia describes two cases of bilateral marginal degeneration of the cornea which were not accompanied by an inflammatory process. In one of these cases a biopsy was done and the histologic findings are reported. The various theories of pathogenesis are discussed. Chinaglia's opinion is that this type of degeneration should be classified as a neurodystrophy with a secondarily altered tissue metabolism and consequent degeneration of the parenchyma. (References)

Harry K. Messenger.

Choyce, D. P. **Successful transplantation of human and cat corneal tissue into rabbit corneae.** Brit. J. Ophth. **36**:537-542, Oct., 1952.

Lamellar grafts of human and cat corneas were transplanted into rabbits. The center of the host cornea was removed to Descemet's membrane. A linear-shaped transplant was inserted intracorneally. All the grafts remained clear for two years and would have apparently remained so indefinitely. The significance of these observations is discussed. Orwyn H. Ellis.

De Leonibus, Fernando. **The thickness of the cornea in eyes with iridocyclitis.** Rassegna ital. d'ottal. **21**:407-414, Nov.-Dec., 1952.

The author determined the corneal thickness in 20 subjects with unilateral iridocyclitis, using a modified von Bahr technique. In all there was a considerable increase in thickness, varying from 1.3 to 87.14 percent over the healthy fellow eye. After reviewing the recent literature on the subject, different hypotheses as to the physiopathology are offered. (2 figures, 11 references) Eugene M. Blake.

Eareckson, V. O., Jr., Miller, J. M., and Long, P. H. **Infection of eye due to pseu-**

domonas aeruginosa treated with polymyxin B and "Varidase." A.M.A. Arch. Ophth. **49**:158-160, Feb., 1953.

This is a case report of a patient who developed an infection of the eye due to Pseudomonas aeruginosa after removal of a corneal foreign body. The eye was salvaged by the use of Polymyxin B and "Varidase" (streptokinase-streptodornase). Further clinical trial of this combination is suggested for infections caused by this organism. G. S. Tyner.

Fedukowicz, H., and Horwich, H. **The gram-negative diplobacillus in hypopyon keratitis.** A.M.A. Arch. Ophth. **49**:202-211, Feb., 1953.

Six cases of hypopyon keratitis due to a gram negative diplobacillus were observed. Bacteriologic studies were made and the subject is reviewed. In most cases of central corneal ulcer with hypopyon seen at Bellevue Hospital the infecting organism was a gram-negative bacillus, especially the Morax-Axenfeld bacillus. These findings are in contrast to the high incidence of pneumococcic ulcers reported elsewhere. G. S. Tyner.

Gandolfi, C. **Conjunctival pemphigus.** Arch. di ottal. **56**:133-141, March-April, 1952.

A patient was treated successfully with X-ray therapy (four doses of 150 r each at three-day intervals, repeated after two weeks) and a free conjunctival graft.

John J. Stern.

Klein, M., and Millwood, E. G. **Control of experimental corneal infection with medicated semisolid contact cap and disk.** Brit. J. Ophth. **37**:30-36, Jan., 1953.

Recently Sorsby and his coworkers described successful prevention of pyocyaneus infection by the subconjunctival injection of a single dose of 0.5 gm. of streptomycin dissolved in adrenalin up to three hours after infection. Klein and Millwood describe a series of experiments on pyocyaneus infection using gelatin caps and discs impregnated with streytomycin. Methods of storage and of preservation of the medicated material were worked out with difficulty. In glycerine discs 0.1 gm. of the drug and in an alginate cap 0.06 gm. was sufficient protection against massive experimental infection. Thus it is seen that in a proper vehicle, streptomycin in rather small doses can be very effective. It is recommended that first-aid stations of industrial plants use this method in corneal lacerations and after removal of foreign bodies as an effective preventive. The subconjunctival injection of the larger doses in adrenalin is recommended for treatment of the established infection.

Morris Kaplan.

Lemmingson, W. **Participation of the eye in bullous epidermolysis.** Klin. Monatsbl. f. Augenh. **122**:350-353, 1953.

Two siblings (52 and 42 years old) had the heriditary dystrophic form of bullous epidermolysis of the skin and both had conjunctival scars and superficial corneal opacities. (17 references)

Frederick C. Blodi.

Malbran, Jorge L. **Non-perforating keratoplasty.** Arch. oftal. Buenos Aires **27**: 281-291, July, 1952.

The author describes his technique and the indications for lamellar or non-perforating keratoplasty. The procedures vary according to the purposes for which the operation is performed. He lists four: 1. optical, always central, 2. therapeutic, for example, in luetic or ulcerative keratitis, 3. preparatory, total, subtotal, or partial, and 4. protective and esthetic (total or subtotal, or partial, circular or semilunar), as in extensive and disfiguring leucomas, keratoconus and keratectasia, and recurrent pterygium. Joseph I. Pascal.

Malbran, J. L., and Cremona, A. C. **Corneo-conjunctival plastic with fascia**

lata. Arch. oftal. Buenos Aires **27**:462-472, Oct., 1952.

This is a new material for plastic operations on the cornea and conjunctiva. Eight cases of burns and recent cauterizations were treated with transplants of fascia lata, with varying results; also eight cases of symblepharon, three of recurrent pterygium, and one of tumor, which gave exceptionally good results. It is probable that the cicatrization produced by the transplant of fascia lata is a result of a secondary epithelialization, since it is not possible to assume a transformation of a tissue of mesodermal origin into one of true epithelium. Joseph I. Pascal.

Paycha, F. C. **Method of measuring corneal thickness.** Arch. d'opht. **13**:150-158, 1953.

The author states that measurements of corneal thickness are of great value in following the course of parenchymatous keratitis, and above all in determining the depth of the bed required for lamellar transplant. By means of a micrometer eyepiece in the corneal microscope, and a triangle formed by the beam from the lamp held at an angle of 71° to the visual axis, the thickness can be calculated with an error of only .05 to .07 mm. Each division of the micrometer gauge corresponds to .05 mm. Phillips Thygeson.

Piper, H. G. **External diseases of the eye and their sequelae.** Klin. Monatsbl. f. Augenh. **122**:129-141, 1953.

Many severe affections of the conjunctiva will eventually end in an extensive scarring and drying. The underlying cause may be manifold, but the end result is the same, namely, a loss of function.

Frederick C. Blodi.

Rama, G. **Ulcus rodens (etiopathogenesis and therapy).** Arch. di ottal. **56**:157-174, March-April, 1952.

The literature is reviewed and a patient is described in whom one eye was lost. In another patient the process was arrested by transplantation of labial mucous membrane. (89 references)

John J. Stern.

Riehm, W. **Nonspecific irritation in the pathogenesis of phlyctenular inflammation.** Klin. Monatsbl. f. Augenh. **122**:292-296, 1953

In this disease we assume a selective sensitization of skin and conjunctiva. This could be caused by a special disposition of this specific age group, by a hereditary factor, or by a preceding local damage. The recurrence of a phlyctenule after a nonspecific irritation is not a so-called nonspecific hypersensitivity. It is always a reaction to the specific allergen, but precipitated by a nonspecific irritation. (4 references) Frederick C. Blodi.

Toth, Z. **The pterygium and its surgery.** Klin. Monatsbl. f. Augenh. **122**:307-333, 1953.

A detailed survey of the older literature is given. The author believes that the primary lesion lies in the conjunctiva and that the cornea is only secondarily involved. Various surgical procedures are discussed. The author undermines the pterygium with a Graefe knife. He stresses these important factors: 1. complete removal of the pterygium from cornea and limbus, and 2. replacement of the excised tissue by normal conjunctiva or by a mucous membrane plastic. (71 references, 12 figures) Frederick C. Blodi.

Vidal, F. **Zeissitis caused by the round pityrosporum.** Arch. oftal. Buenos Aires **27**:358-363, Aug., 1952.

The author describes a new clinical entity, called mycotic Zeissitis, which consists of a biochemical alteration of the secretions caused by the pityrosporum. The fungus is round and its clear sheath is made up of lipoproteins. During its

growth and expansion it can invade the conjunctival sac and produce severe conjunctivitis and chronic keratitis. But the most noteworthy fact is that it produces an allergic condition of the sac which is aggravated by any procedure, especially surgical intervention. Mucin and lipotropic agents tend to arrest the development of the pityrosporum.

Joseph I. Pascal.

Wagner, F. **Bilateral keratoplasty in macular corneal dystrophy.** Klin. Monatsbl. f. Augenh. **122**:261-272, 1953.

A 60-year-old woman with typical macular dystrophy of both corneas improved considerably after keratoplasty. The histologic examination revealed a severe degeneration of Bowman's membrane and areas of destruction in the superficial lamellae. A fine granular substance (hyaline?) was evenly distributed in all the layers of the cornea, including the epithelium. (15 references, 9 figures)

Frederick C. Blodi.

8

UVEA, SYMPATHETIC DISEASE AQUEOUS

Bonnet, P., and Bonnet, I. **Ocular manifestations in chronic arthritis of childhood. Still's Disease. Ankylosing and deforming rheumatism.** Arch. d'opht. **13**: 127-145, 1953.

The authors conclude that in chronic rheumatism of childhood, whether the Still's disease type or the ankylosing polyarthritis type, important ocular lesions develop in about 20 percent of the cases. These lesions are almost always bilateral and consist essentially in a chronic iridocyclitis associated with band-shaped opacity of the cornea and complicated cataract. The early ocular symptoms sometimes are not recognized by pediatricians and for this reason the authors urge ophthalmological examination of every child with arthritis. They consider band-shaped keratopathy in a child as almost pathognomonic of rheumatoid disease.

Phillips Thygeson.

Hogan, M. J. **Diseases of the uveal tract.** A.M.A. Arch. Ophth. **49**:342-363, March, 1953.

The pertinent literature appearing between October, 1951, and October, 1952, is reviewed. G. S. Tyner.

Velissaropoulos, P. **Sarcoma of the choroid.** Arch d'opht. **13**:159-166, 1953.

In a clinical and anatomopathologic study of 37 cases of sarcoma of the choroid and ciliary body, the author found the incidence of the condition to be one per 5,675 eye patients. In his series there were 21 men and 16 women. The right eye was involved 21 times, the left 16 times; there were no bilateral cases. Nine of the patients were less than 40 years of age and one was only 3 years of age. The various clinical features of the disease are described and analyzed; among them are corneal sensitivity and pupil displacement in tumors of the anterior segment, and retinal detachment and intraocular tension in tumors of the posterior segment. The essential histopathologic characteristics of the tumor are described. The author stresses the importance of anterior segment symptoms, especially the sector-like dilatation of the conjunctival and episcleral vessels, the sector-like hypoesthesia of the cornea, and the distortion of the pupil. He suggests that the increase in ocular tension is due to the difficulty in absorption of albumin-rich subretinal fluid rather than to the volume of the tumor. Phillips Thygeson.

Vit, H. **The operative treatment of a long standing, postoperative choroidal detachment.** Klin. Monatsbl. f. Augenh. **122**:286-292, 1953.

Three cases of long standing detachment of the choroid are discussed. In one

a fistulating wound had to be repaired. The other two cases were treated by injection of air into the anterior chamber. (22 references) Frederick C. Blodi.

9

GLAUCOMA AND OCULAR TENSION

Benton, C. D., Jr. **Glaucoma following occlusion of central retinal artery.** A.M.A. Arch. Ophth. **49**:280-284, March, 1953.

Two patients are reported who developed sudden severe unilateral glaucoma a few weeks after occlusion of the central retinal artery. The clinical picture of glaucoma did not differ essentially from that following occlusion of the central retinal vein. Pathologic findings are reported on one case in which the affected eye was enucleated. G. S. Tyner.

Ferraris de Gaspare, P. F. **Goldmann's artificial scotoma in provocative tests for diagnosis of chronic glaucoma.** Boll. d'ocul. **32**:43-57, Jan., 1953.

Measurements of the angioscotomas, artificial scotomas, intraocular pressures and intraocular arterial pressures of eyes affected by early glaucoma were performed and compared to those obtained after provocative tests such as awakening, caffeine, lability test, water-drinking test, combined drinking and congestion test, and compression test, plotting the scotoma 15 minutes after cessation of compression. Twelve sketches of central fields and one table demonstrate the findings, comparing eight patients with early glaucoma with ten glaucoma-free persons. The results are comprehensively described and discussed; some of them seem to be of practical interest. After caffeine administration the angioscotoma is often enlarged while the artificial scotoma shrinks in some cases. (References) K. W. Ascher.

Gonzalez-Pola, Angel Moreu. **The concept of true glaucoma.** Arch. oftal. Buenos Aires **27**:381-394, Sept., 1952.

The author stresses the importance of differentiating true glaucoma from secondary hypertension. True glaucoma is a chronic affection and the only glaucoma which passes through three stages, preglaucoma, prodromal glaucoma, and actual glaucoma. The stage of preglaucoma must be understood in the sense in which the author described it in 1944, and not that in which Gradle referred to a typical prodromal glaucoma which has gone beyond true preglaucoma. It is necessary to continually check the tension and its rhythm. Every patient with suspected preglaucoma must be examined day after day, as Gonin recommended. True glaucoma never begins in an acute attack. All patients thus diagnosed were poorly examined, since they must have had previous signs and symptoms, or else a secondary hypertension. Many acute glaucomas which are completely cured by an iridectomy are secondary hypertensions. A clinical cure can be obtained merely by regulating the tension. Oscillations of tension give a bad prognosis. The ophthalmologist must consider the glaucomatous patient as one who has suffered a basic alteration in his endocrine-neuro-vegetative system, with repercussions in the circulation of the blood and the intraocular fluids. Two phases are recognized, one overproduction of aqueous, and the other a mixed phase of overproduction alternating with underexcretion. The co-existence of both phases gives rise to the acute inflammatory form. Joseph I. Pascal.

Greaves, D. P., and Perkins, E. S. **Influence of the third cranial nerve on intraocular pressure.** Brit. J. Ophth. **37**:54-57, Jan., 1953.

Since cholinergic drugs are often effective in lowering ocular tension, it seemed probable that direct stimulation of the parasympathetic nerves in the third nerve might have the same effect if the third nerve was exposed in its intracranial

course in decerebrated rabbits and stimulated while both blood pressure and ocular pressure were recorded. The stimulation produced a rise in ocular tension. The rise was proved to be due to contraction of the extra-ocular muscles. Neither section nor stimulation of the third nerve had any significant effect on the ocular tension.

Morris Kaplan.

Kaneda, S., and Kiritoshi, Y. **Type of phasic variation of glaucomatous ocular tension.** Acta Soc. Ophth. Japan **57**:235-239, May, 1953.

In 49 eyes with wide-angle glaucoma, the phasic variation of ocular tension was followed. Double-variation type, rising type, falling type and flat type of Langley's classification were found in 17, 12, 10 and 10 eyes respectively. Among 17 other eyes with narrow angle glaucoma, they were found in 2, 5, 5, and 5 eyes respectively in the order given above. The figure differs greatly from that given by Langley. The authors consider, therefore, that the type of the variation is unimportant although the variation itself is very important in the diagnosis of glaucoma.

Yukihiko Mitsui.

Kleinert, H. **The closure of the angle in acute glaucoma.** Klin. Monatsbl. f. Augenh. **122**:196-202, 1953.

The author saw a thickening of the trabecular area of the chamber angle in some cases of acute glaucoma. This, rather than the pushing forward of the root of the iris, could be the cause for the closure of the angle.

Frederick C. Blodi.

Loehlein, H., and Glasenapp, L. V. **Our experiences with the trephine-cyclodialysis.** Klin. Monatsbl. f. Augenh. **122**:179-195, 1953.

100 eyes were operated on according to this modification of cyclodialysis described by Sallmann. The eyes were examined with a gonioscope before and after the operation. 75 of these eyes had a normalized pressure, 20 were hypotonic; 66 showed an open cleft in gonioscopic examination. Intraoperative hemorrhages did not influence the result.

Frederick C. Blodi.

Miller, S. J. H. **Intraocular pressure in primary congestive glaucoma.** Brit. J. Ophth. **37**:1-10, Jan., 1953.

In early congestive glaucoma several findings are almost always present and distinguish the disease from chronic simple glaucoma with which it is frequently confused. The two diseases are entirely separate entities early, although they become closely similar in later stages. In the congestive type the chamber angle is narrow; the peripheral and central fields are normal; there is no cupping of the disc; emotional upsets, visual concentration, movies, television, menstrual cycle and darkness bring on an attack of elevated tension, and rest or sleep promptly relieve the hypertension as well as the discomfort. Between attacks the tension is quite normal and usual provocative tests bring no positive response. Halos and pain in the eye are the typical subjective complaints during the attacks; these tend to occur in younger people and recur with progressive frequency. Miotics or surgery result in relief in most cases.

In chronic simple glaucoma the picture is quite different in that the progress is very insidious usually without subjective complaints but with steady loss of vision and of fields. The tension is either elevated constantly or can be made so with the provocative tests and the chamber angle may be shallow or deep. Rest or sleep do not relieve the condition nor is it always relieved by miotics or surgery.

Morris Kaplan.

Redi, F., and Isola, R. **The value of X-ray applications for the maintenance of a filtrating scar after anterior sclerectomy.** Arch. di ottal. **56**:117-131, March-April, 1952.

In order to reduce the postoperative proliferation of granulation tissue and secondary blockage of the sclerocorneal opening, the authors administered 600 to 900 r in four or five sessions, beginning three to five days after the anterior sclerectomy, at the site of operation. A well-filtering cystoid scar was obtained in 12 of 14 patients who were under observation for from six months to 3½ years.

John J. Stern.

Riffenburgh, R. S. **Glaucoma associated with Krukenberg's spindle.** A.M.A. Arch. Ophth. **29**:341, March, 1953.

A case of probable unilateral pigmentary glaucoma in a 21-year-old man is reported. A Krukenberg's spindle was associated with the heavy pigmentation of the anterior chamber angle. The diagnosis was made by means of a positive water-drinking provocative test. G. S. Tyner.

Sorsby, A., Franceschetti, A., Joseph, R., and Davey, J. B. **Choroideremia. Clinical and genetic aspects.** Brit. J. Ophth. **36**:547-581, Oct., 1952.

It is now established that choroideremia is an independent affection unrelated to retinitis pigmentosa. Whether the affection is congenital is still not known, though there is no doubt that it is progressive. It is likewise certain that choroideremia is unrelated to gyrate atrophy. Nearly all the cases recorded were men. In many instances, one or more brothers were affected. The choroidal vessels were either sclerosed or absent. The choroidal changes were regarded as the primary lesion. Though the affection is progressive, it bears no direct relationship to age. Though generally more advanced in the elderly, it may yet be fully developed in the relatively young and only partially so in older men. Some relatively healthy tissue tends to remain like a golden halo around the disc until toward the very end. In the earliest stage there is some peripheral atrophic reaction with exposure of choroidal vessels. In the intermediate stage there is considerable atrophy. The fundus reflex assumes a yellowish coloration and ultimately ends in the dead white reflex seen in the advanced stage. The pointing symptom is nightblindness. In most cases blindness does not set in until about the age of 40 years. The present study confirms the observation that in women the carrier state, though ophthalmoscopically fairly obvious, is stationary and asymptomatic. Choroideremia is inherited in an intermediate sex-linked manner. An account is given of three families with choroideremia. It is suggested that the affection would be better designated "progressive choroidal atrophy."

Orwyn H. Ellis.

v. Wolffersdorff, H. **Ciliocyclodiathermy.** Klin. Monatsbl. f. Augenh. **122**: 333-344, 1953.

In this variation of the nonperforating cyclodiathermy superficial coagulations are set in front and beneath one of the horizontal rectus muscles in an attempt to close a long posterior ciliary artery. If the intraocular pressure rises during or after the operation two perforating diathermy applications are set beneath the muscle. This operation was performed on 50 eyes, in 20 eyes as a primary procedure. The results were encouraging. (1 figure, 3 charts, 18 references)

Frederick C. Blodi.

10

CRYSTALLINE LENS

Alagna, G. **"Rubella embryopathy" and anterior lenticonus.** Arch. di Ottal. **56**:185-213, May-June, 1952.

A young man of 20, whose mother had had rubeola at the end of the second month of pregnancy, exhibited a bilateral anterior lenticonus, atypical retinitis pigmentosa, mental deficiency and hypoacousia. It can be assumed that the maternal disease allowed the virus to interfere with

the development of the lens but the influence of postnatal factors on the congenitally weakened lens capsule cannot be excluded. John J. Stern.

Alter, A. J., and Leinfelder, P. J. **Roentgen-ray cataract.** A.M.A. Arch. Ophth. **49**:257-260, March, 1953.

A specific amount of the longer Xrays given in a single dose is more cataractogenic than the same r dosage of short rays given in divided doses over a period of several days or weeks. Experiments were done to determine whether Roentgen-ray cataract is due to a direct effect of the rays on the lens itself or an indirect effect which is the result of impaired nutrition brought about by injury to blood vessels of the ciliary body. It was found that cataract occurred only when the lens itself was directly exposed. A 2-mm. thick lead shield is adequate to protect the lens. The equatorial portion of the lens is the region most sensitive to Xrays and the pupillary zone the least sensitive. Exposure of one quadrant of the lens results in opacities limited to that quadrant. G. S. Tyner.

Cavara, V., and Ciotola, G. **Three patients operated on for cataract by Ridley's method.** Boll. d'ocul. **32**:129-133, March, 1953.

Three paients, all older than 74 years, were operated on extracapsularly and the acrylic lens devised by Ridley was deposited behind the iris (authors write: into the capsule). In spite of the inconveniences encountered, the authors recommend the method for further trial. (References) K. W. Ascher.

Davids, B. **Conservative treatment of senile cataract.** Klin. Monatsbl. f. Augenh. **122**:296-306, 1953.

The author does not believe that senile cataract is a genetically determined disease. He believes its development can be influenced by a diet rich in vitamins and by the administration of sex hormones. Out of 16 eyes, however, 6 showed increased lens opacities while under treatment. (22 references, 12 figures)

Frederick C. Blodi.

Kara, G. B. **Histologic appearance of an eye four days after cataract extraction.** A.M.A. Arch. Ophth. **49**:285-292, March, 1953.

This is a histologic report with 10 photomicrograhs of an eye enucleated four days after cataract extraction. Of special interest is the reaction around chromic gut suture placed in the sclera. The sclera showed necrosis around the suture and epithelialization. Despite the use of appositional sutures, there was posterior gaping of the wound with resultant tissue inclusion. G. S. Tyner.

Malbran, J. L., and Salleras, A. **Immediate results of inserting a plastic lens after cataract operation in 15 cases.** Arch. oftal. Buenos Aires **27**:440-446, Oct., 1952.

The authors found that the plastic lenses were perfectly tolerated by the eyes, and that the post-operative iritis was of the same kind as that ordinarily found after an extracapsular extraction. There is no possibility of luxation of the lens as it is permanently anchored to the iris, but the immediate visual results are poor. There is no need to calculate what lens to use, because with the standard lens all the patients showed emmetropia. There are no technical difficulties in implanting the lens, nor in keeping it in place. The barrier presented by the Ridley lens prevents secondary escape of vitreous into the anterior chamber with the resultant grave consequences of retinal detachment and chronic corneal edema. There is no danger of the lens becoming decentered and producing false projection or binocular diplopia. The procedure is recommended in monocular cataract, especially of the mature and hypermature type. The method has a great future when it is perfected so that it can also be used after intracapsular extraction.

Joseph I. Pascal.

NEWS ITEMS

Edited by Donald J. Lyle, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month but, to receive adequate publicity, notices of postgraduate courses, meetings, and so forth should be received at least three months before the date of occurrence.

Deaths

Dr. Murray A. Last, New York, died at his office, 1095 Park Avenue, Thursday afternoon, June 25, 1953, of a coronary thrombosis. He was 52 years old.

Dr. Last was born in New York and was graduated from New York University-Bellevue Medical School in 1927. He was ophthalmic surgeon at the Manhattan Eye, Ear, and Throat Hospital and ophthalmologist at Midtown Hospital, consulting ophthalmologist at the Lexington School for the Deaf, and former chief of the eye clinic at Mount Sinai Hospital.

He was a diplomate of the American Board of Ophthalmology and a fellow of the American College of Surgeons and the New York Academy of Medicine.

Societies

AOS officers

At its recent meeting the American Ophthalmological Society elected the following officers for the coming year: President, Dr. William L. Benedict, Rochester, Minnesota; vice-president, Dr. Everett L. Goar, Houston; secretary-treasurer, Dr. Maynard C. Wheeler, New York; editor, Dr. Gordon M. Bruce, New York.

Announcements

Georgia meeting

The spring meeting of the Georgia Society of Ophthalmology and Otolaryngology will be March 5 and 6, 1954, at the General Oglethorpe Hotel, Savannah, Georgia. The speakers will be: Dr. Paul Chandler, Boston; Dr. A. B. Reese, New York; Dr. Henry P. Wagener, Rochester; Dr. L. R. Boies, Minneapolis; Dr. Francis LeJeune, New Orleans; and Dr. J. H. Maxwell, Ann Arbor, Michigan.

Memphis convention

Guest speakers at the annual convention of the Memphis Eye, Ear, Nose, and Throat Society to be held on February 6, 7, and 8, 1954, will be: Dr. Daniel B. Kirby, New York; Dr. Lewis F. Morrison, San Francisco; Dr. Jerome A. Hilger, St. Paul; Dr. Charles A. Perera, New York; Dr. John M. Converse, New York; and Dr. Kenneth C. Swan, Portland, Oregon.

Research Study Club conference

The Research Study Club of Los Angeles announces its 23rd annual midwinter clinical convention, January 18 through January 29, 1954. Among the guest speakers for the eye program will be Dr. Daniel B. Kirby, New York; and Dr. Frank D. Costenbader, Washington. For further information address: Dr. Pierre Violé, 1930 Wilshire Boulevard, Los Angeles 5.

Oxford program

After the address of welcome by Mr. Frank W. Law, the following program was presented at the Oxford Ophthalmological Congress held July 6th through 8th at Oxford, England:

"Visual requirements in relation to modern travel," with the discussion opened by Sir Stewart Duke-Elder, Air Commodore J. C. Neely, and Prof. W. J. B. Riddell; Mr. H. B. Stallard showed a film on "Dacryocystorhinostomy," Dr. J. A. E. Primrose and Dr. F. W. Campbell spoke on "The state of accommodation of the eye in darkness"; Mr. Peter Hansell discussed "Illustrating the lecture"; Mr. Frederick Ridley, "Contact lenses in unilateral aphakia"; Mr. T. Keith Lyle, "Orthoptic aspects"; Dr. M. Lederman, "Radiotherapy of epibulbar malignant melanomas"; Mr. A. Seymour Philps showed color films on "Corneal grafting" and "Intracapsular and acrylic lens operations."

Mr. V. Purvis spoke on "Some considerations upon the value of early visual acuity tests in the school child"; Mr. J. Gloster, "Factors influencing the visual judgement of the vertical direction"; Mr. J. Wheeler, "Anesthesia and akinesia in ocular surgery"; Dr. A. Huber, "The relationship between the retinal and the cerebral vessels"; Mr. H. E. Hobbs and Mr. E. D. L. Simpson, "Systemic hormone treatment of posterior uveitis"; Mr. M. Sarwar, "Some observations on the physiology of the cornea."

Dr. J. Marshall, Mr. D. Ainslie, and Miss M. B. MacKellar led the discussion on "Ophthalmic nursing"; Mr. F. A. Williamson-Noble, "Cataract extraction after a glaucoma operation"; Mr. C. Dee Shapland presented a film on "Lamellar sclerectomy."

The Doyne Memorial Lecture was delivered by Mr. T. Keith Lyle of London. The subject of his address was "Factors which affect the prognosis and treatment of ocular palsy."

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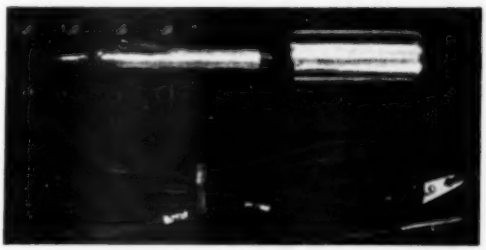

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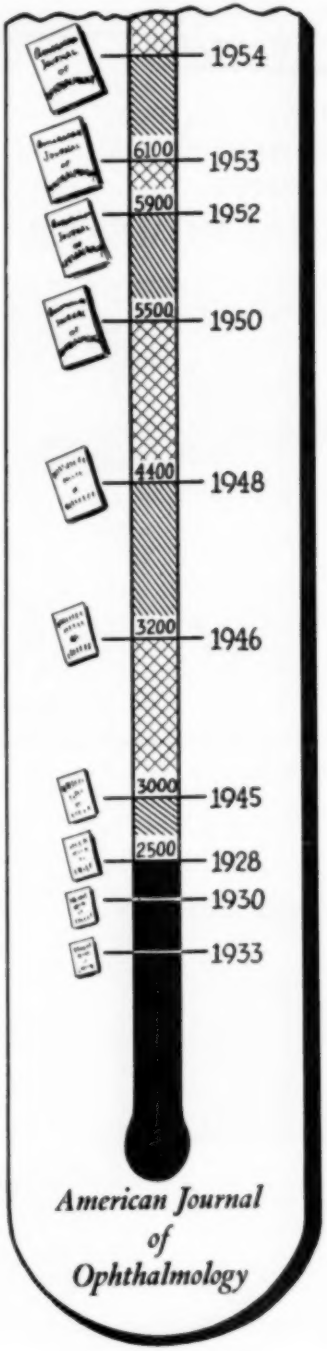
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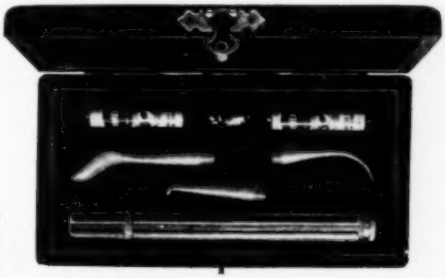

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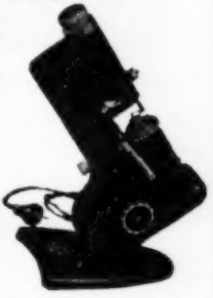

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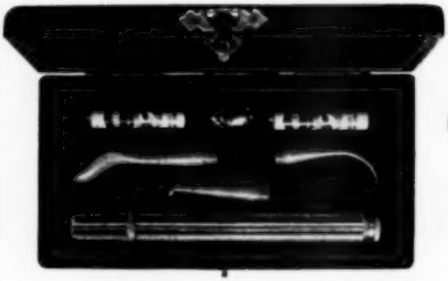

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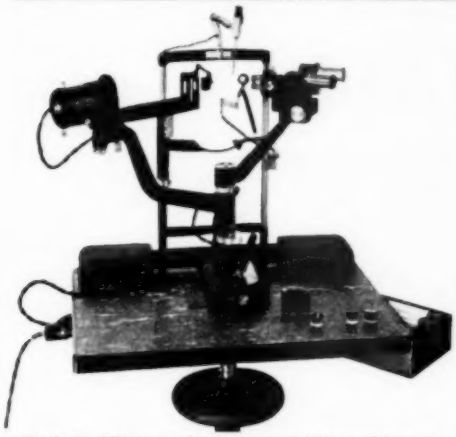

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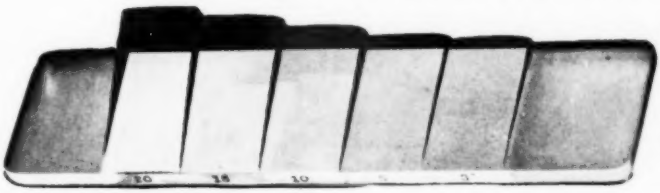

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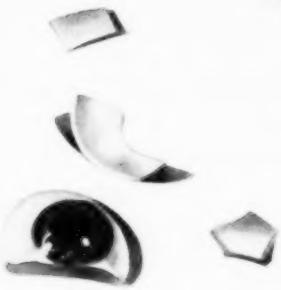

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